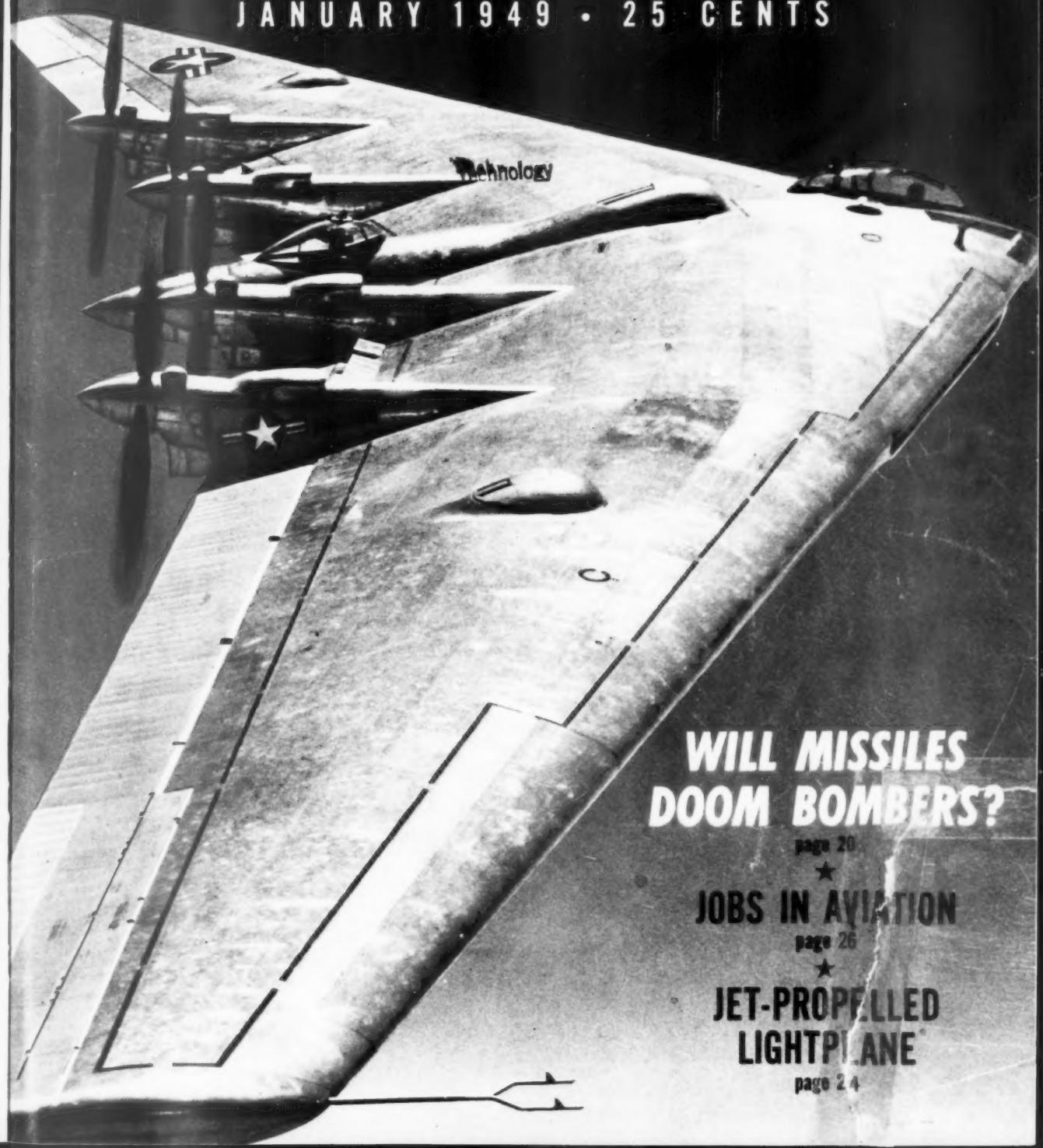
THE TRUE STORY OF PEARL HARBOR page 15

FLYING

JANUARY 1949 • 25 CENTS



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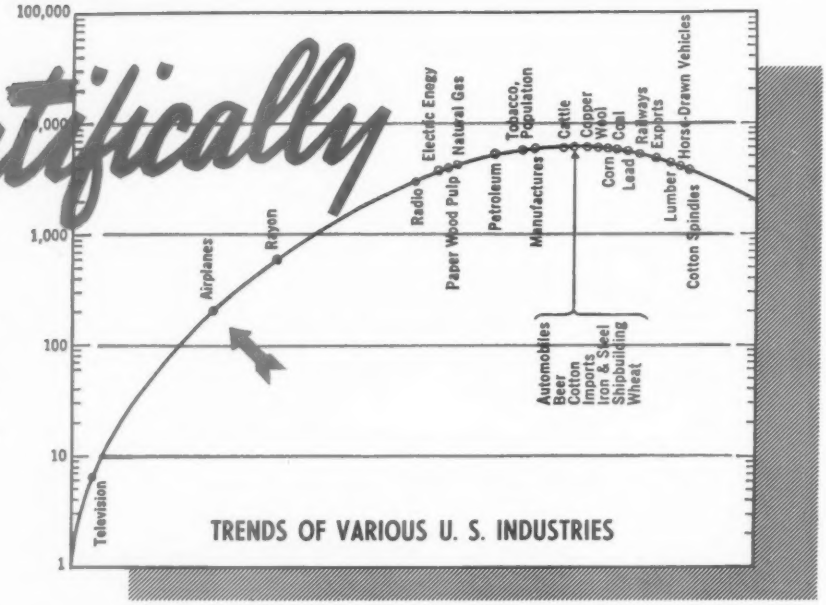

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THE COVER: Northrop's B-35 Flying Wing. Most are now being converted to jet B-49s.

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Assistant Publisher
MICHAEL H. FROELICH

Managing Editor
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Associate Editors
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NEW YORK (1)
Empire State Bldg., WI 7-0400

LOS ANGELES (14)
815 S. Hill St., TUcker 9213

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ASSOCIATED COMPANY

Ziff-Davis, Ltd., Grampians Bldg. Western Gate, London, England

FLYING

JANUARY • 1949

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185 North Wabash Ave., Chicago 1, Ill.
Member of the Audit Bureau of Circulations
VOLUME 44 • NUMBER 1

FLYING is published monthly by Ziff-Davis Publishing Company at 185 N. Wabash Ave., Chicago 1, Ill. SUBSCRIPTION RATES: In U. S., Canada, Mexico, South and Central America and U. S. Possessions, $3.00 for twelve issues; in British Empire, $4.00; all other foreign countries, $4.00 for twelve issues. Subscribers should allow two weeks for the change of address. Address all subscription letters to the Director of Circulation, FLYING, 185 North Wabash Avenue, Chicago 1. Entered as second class matter, September 8, 1942, at the Post Office, Chicago, Illinois, under the act of March 3, 1879. Entered as second class matter at the Post Office Department, Ottawa, Canada. Contributors should retain copy of contributions. All submitted material must contain return postage. Contributions will be handled with reasonable care, but this magazine assumes no responsibility for their safety. Accepted material is subject to whatever adaptations and revisions are necessary to meet requirements. Payment covers all authors', contributors' and contestants' rights, title and interest in and to the material accepted and will be made at our current rates upon acceptance. All photos and drawings will be considered as part of the material purchased.

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THE MAIL BOX

FLYING'S AIRSEDAN

. . . What ever happened to the FLYING *Airsedan*, suggested in 1945 by your magazine as an "ideal" post-war plane?

BOB MCLANE
Seattle, Wash.

Have there been any developments on this proposed plane? . . . am I to assume the whole matter has fallen through? I sincerely hope not, as I frankly feel that with a reasonable selling price such a plane should sell like hot cakes.

ARTHUR B. CRAWFORD
Austin, Tex.

In 1945 or 1946, FLYING compiled the results of a questionnaire poll and designed the "ideal post-war plane." After all data was collected and plans were drawn, they were published in the magazine. What issue?

RICHARD W. WEIBLEY
Harrisburg, Pa.

● A French plane, the *Courlis*, similar to FLYING'S *Airsedan*, went into production

. . . Airsedan

in 1947. A new U. S. plane, the Anderson-Greenwood 14 (see page 41), also closely resembles the *Airsedan*, which was first described in FLYING, August 1945. The Anderson-Greenwood plane is not yet certificated.

THE GNATTY WELKIN

Your November issue contains a letter asking: "Who is this Sheridan character?" and "Why always pick on CAA?"

When you ask who is this Sheridan character I have to say that I haven't got to that question yet. I am still working on *where* am I . . . The question of character will be covered in the Statistics Department below.

First about CAA. Ordinary uninspired humorists use mothers-in-law and such trite things, as their equipment, to hang their quips on, you know. Will Rogers used congressmen . . . I use the CAA, engineers, vice-presidents and myself. Can you think of some other hounds to worm?

As to statistics I will have to admit that I am not familiar with them and really never had a chance to be since we didn't have any statistics in our family. I was an only child.

Yours for Sadie the Stewardess who says that I have a talent for writing—I practically write by instink.

HY SHERIDAN
Oak Park, Ill.

BRAINS ALSO NEEDED

. . . It burns me up to work for three months collecting information, soliciting help, paying a few bills and working for a week painting an airmarker and then see some Gizmo circle overhead for an hour at 1,000 feet without seeing it.

But that's what happened here the other day. A cross-country pilot circled a marker for 60 minutes until his fuel ran out, then proceeded to a field north of the marker and wrecked his J-3.

I realize that nothing can take the place of common sense but many of our private pilots have never been taught to read an airmarker when they see one. Many aren't even trained in the technique of orientation when lost on a cross-country.

RALPH E. DIAL
Lenoir City, Tenn.

KNIGHT TWISTER

Can you tell me what aircraft company builds the Knight *Twister*? . . .

FRED J. RING
Richmond, Calif.

● The Knight *Twister* is sold by the Knight Twister Aircraft Corporation of St. Louis, Mo. A few months ago, Designer Vernon W. Payne made a preliminary application to CAA for an airworthiness certificate but flight tests for certification have not been made. As in the past, a person who buys a Knight *Twister* kit can legally build the aircraft—but he cannot legally fly it without certification. While theoretically an individual could provide the data for possible certification, such an undertaking by an individual purchaser would be prohibitively involved and expensive. None has done so to date.—ED.

WORLD'S LONGEST RUNWAY

After reading an old issue of FLYING (May, 1948) for about the fourth time a flagrant error made itself apparent. Joseph Barry says the "world's longest paved runway" is located at Kirtland Field, N.M.

I have some information in an Air Force publication which credits the Lagens Air Force Base at Terceira Island in the Azores with a north-south paved runway 10,600 feet long.

SGT. CHARLES MILLS
Westover Air Force Base, Mass.

● Kirtland Field's 10,170-foot paved runway falls 430 feet short of matching the Lagens paved runway length.—ED.

"MOST COMFORTABLE, ROOMY PLANE"...say Navion Owners

"A REALLY FULL-SIZED 4-PLACE CABIN"—"Most comfortable"—"Restful and relaxing"—"Superb visibility"—are typical answers several hundred *Navion* owners gave when asked what they thought of their planes. Every day more executives and professional men are discovering that the *Ryan Navion* is the ideal personal and business plane. There are good reasons. Front seats are individually adjustable, ventilation is draft-free. Improved sound insulation and smooth-as-silk stability—even in rough air—give quiet relaxation. The exclusive roll-back canopy gives easiest exit and entrance for rear-seat passengers. And there's loads of space for luggage or cargo. See how you can profitably use a *Ryan Navion* in your business or profession. Write us today on your letterhead for a free, fully-illustrated brochure, and ask about a free demonstration flight. There's no obligation.

"SAFE"—"EASY-TO-FLY" was No. 1 on the long, favorable list of comments about the 150-mph *Navion*. Almost every owner stressed *Navion's* effortless flying and the patented inter-connected aileron and rudder control that permits steering with wheel alone, but gives you rudder when you need it. That's why owners agree the safe, dependable *Navion* virtually flies itself!

"RUGGED"—"DON'T HAVE TO BABY IT"—"Can really take it"—these were high on the list of *Navion*-owner comments. The ability of the thick-skinned, all-metal *Navion* to withstand heavy-duty punishment, in all kinds of weather, on rough or improvised fields, is one big reason why *Navion* owners fly anywhere they want to go...and do it as cheaply as driving a car.

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NOTES ON CIVIL FLYING

. . . **Four hundred sixty-two personal planes** were delivered by manufacturers during October. The total for the first 10 months of the year is 6,515 deliveries compared with nearly 15,000 during the comparable period of 1947.

. . . **General Tire & Rubber Company** has developed a plastic flight plan card to be attached to instrument panels. The card lists the information necessary for filing the flight plan, and helps to reduce radio tie-ups and facilitate CAA clearance. Pilots can obtain cards by writing to Chief Pilot Ted Migdal, Public Relations Department, General Tire & Rubber Company, Akron, O.

. . . **Two new fire-resistant** hydraulic fluids have recently been announced. The first is a joint development of the Douglas Aircraft and Monsanto Chemical companies. The second was developed by Standard Oil Company of California.

. . . **Engineers** concerned with the problem of landing high-speed planes with sweptback wings have decided that wings with variable sweepback are feasible. The variable wing plane could use a straight wing for take-off and landing. The sweepback could be adjusted depending upon the Mach number.

. . . **Most private pilots** in California fly only for business or for business and pleasure combined, according to a CAA survey. Only 25 per cent of pilots questioned, and those in the least active group, fly only for pleasure.

. . . **First deliveries** of the VRA-1 Narco VHF receiver were scheduled to begin about November 15. The receiver was developed under contract with the CAA to provide VHF two-way communication low enough in cost for private pilots. With the Narco omni-range converter, pilots will be able to use a left-right needle to navigate visually with the new CAA omni ranges. The VHF unit (less the converter) weighs 10 pounds and will sell for less than $400. Omni-range converter equipment is expected to be available soon.

. . . **Scheduled** airlines of the world, exclusive of Russia, operate about 3,646 planes—83 per cent more than 10 years ago, although traffic has increased at least 1,000 per cent. Seventy-eight per cent of all commercial airline transports now in use were built in the United States, according to the Aviation Research Institute, Washington. Douglas DC-3 and C-47 types outnumber all others with 1,655.

. . . **Non-scheduled airline** travel in 1948 is about three times that of the previous year—despite the loss in traffic among scheduled airlines, according to Frank X. Connolly, New York Regional Manager of Associated Airlines Agency, Inc. Main reason for the increase in non-sched travel is the popularity of coast-to-coast "coach fares."

. . . **Cessna** has increased the prices on its 190 series to $13,250 for the Cessna 190 and $14,950 for the Cessna 195. Both models are completely equipped.

Seattle-Tacoma airport's ultra-modern administration building will open about April 1.

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- Gear Indicator Lights
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- Parking Brakes
- Dual Controls
- Cabin Heater
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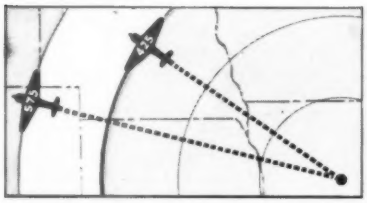
- Aeromatic® Propeller (Deluxe Models)
- Two-Way GE Radio (Deluxe Models)



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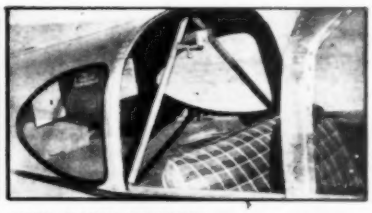

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MILITARY NEWS

An Air Academy similar to the Army's West Point and the Navy's Annapolis is contemplated by the National Military Establishment. In the meantime, Defense Secretary James V. Forrestal has authorized Air Force to obtain officers from 1949 graduating classes of the Naval and Military academies. Up to seven per cent of the Annapolis graduates and up to 40 per cent of the West Point graduates will go into the Air Force.

Ten Northrop B-35s, giant flying wings powered by reciprocating engines, will be converted into turbo-jet B-49s. The remaining three B-35s (see FLYING cover) will be given further flight tests.

Atom-powered planes and guided missiles of 1,200-1,500 m.p.h. speeds will form the Air Force's backbone by 1960, pioneer aircraft designer John K. Northrop predicts.

A "rotochute," supersonic parachute capable of lowering delicate research instruments from rockets shot into the upper atmosphere, has been developed by General Electric. It resembles a giant dart with a whirling propeller on its tip. At the peak of the rocket's flight, the 'chute is expelled. As it falls and the air becomes denser, the blades begin to revolve and are gradually forced out into a horizontal position. This acts as a brake, and the device is slowed from supersonic speed to about 27 m.p.h.

Safety records were topped by Naval Air Training Command this fall. Planes of the command flew over 150,000 flight hours without a fatal accident, compared with an average fatal crash rate of about 8.55 for that number of hours. Over half of the time was flown by "Weekend Warriors," Naval Reserve pilots who fly only on weekends and in spare time.

Twelve GCA units costing $2,800,000 were recently ordered by the Navy as normal replacements for its 36 operational units. Nine of the Navy's GCA installations are on fields outside the U.S. and three are used by the Marine Corps.

National Guard planes constitute over two-thirds of fighters available for air defense of the U. S. today.

Beech Aircraft will modify and overhaul 457 military twin-engined Beechcrafts for the Navy. The reconversion contract will probably total $6,000,000. At least five years will be added to the service life of each plane overhauled, Beech officials say.

Navy's air strength will reach 14,500 planes by July. In 1949, 1,165 Navy planes will be built, including 576 jet fighters, 454 attack aircraft, 82 patrol planes, 16 transports and 37 helicopters. About 3,000 World War II-type planes now in storage will be reactivated.

A machmeter, in case you've wondered, is a simple-appearing device resembling an airspeed indicator. It indicates plane speed in proportion to the speed of sound.

Take-offs straight up will be possible with future jet fighters, says Hall Hibbard, a Lockheed vice-president. A "stripped" F-80 could make such a take-off from a catapult if it had an engine capable of 10,000 pounds thrust. Such an engine, he stated, is not far off for fighter planes.

Douglas C-124, Air Force cargo plane, will probably make its first flight in about 12 months.

The X-1, Air Force's rocket-propelled test plane, has flown 1,000 m.p.h., aviation experts deduce. Lieut. Gen. George E. Stratemeyer recently stated that "human flight at 1,000 m.p.h. is no longer a hangar day-dream."

Charles A. Lindbergh is acting as an AF consultant on Alaska air technical problems. He is inspecting Alaskan and Pacific air bases.

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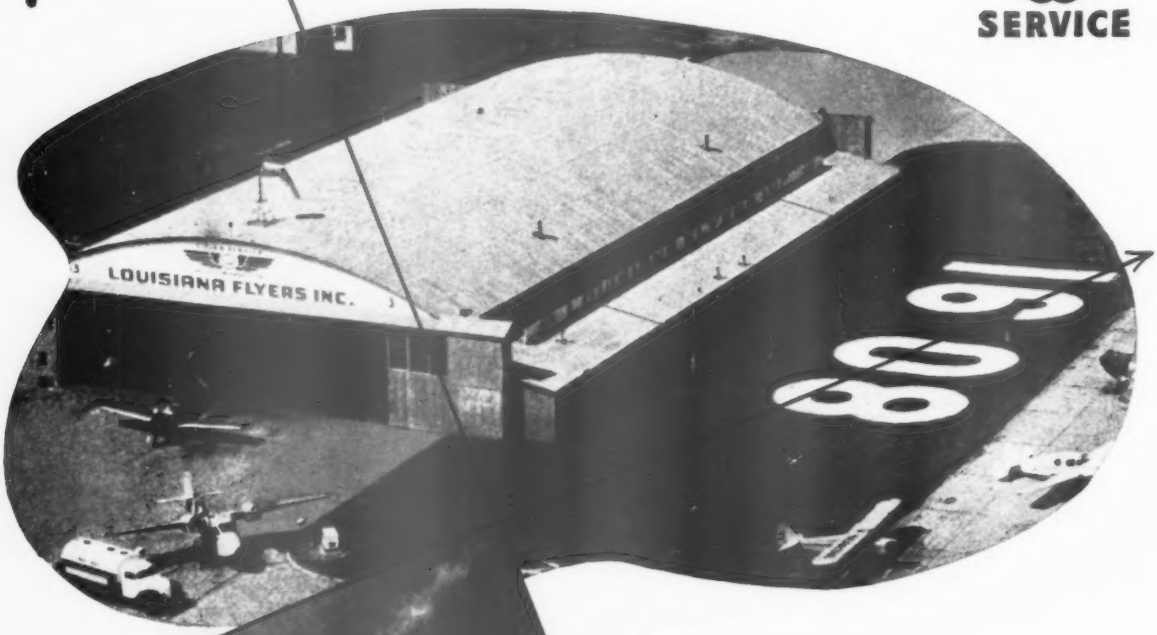

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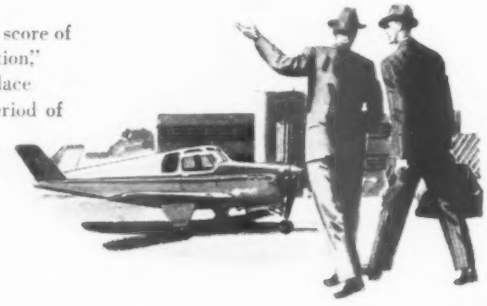
Executive who never flew a plane before

is on his way by *Bonanza* in 12 hours

"I don't know where this idea came from that you have to be a long-experienced pilot in order to be a Bonanza-businessman," declares Francis D. Wetherill, executive of John Wanamaker's, Philadelphia. "With no previous aviation experience, I bought a Beechcraft Bonanza—and was on my way after only twelve hours of instruction. It's the plane—not me. I find it perfectly simple and easy to fly. And no investment I ever made paid me bigger dividends!"

"Bonanza-businessmen, as Mr. Wetherill calls them, have upset a score of traditions in their adoption of this fast, efficient, economical transportation," says Guy Miller of Wings Field, Inc., who delivered Mr. Wetherill's 4-place Bonanza and arranged his instruction. "The idea of a long and arduous period of 'learning to fly'—an idea that has kept all too many executives tied to surface transportation—has been thoroughly dispelled by the sound design and flying characteristics of the Bonanza."



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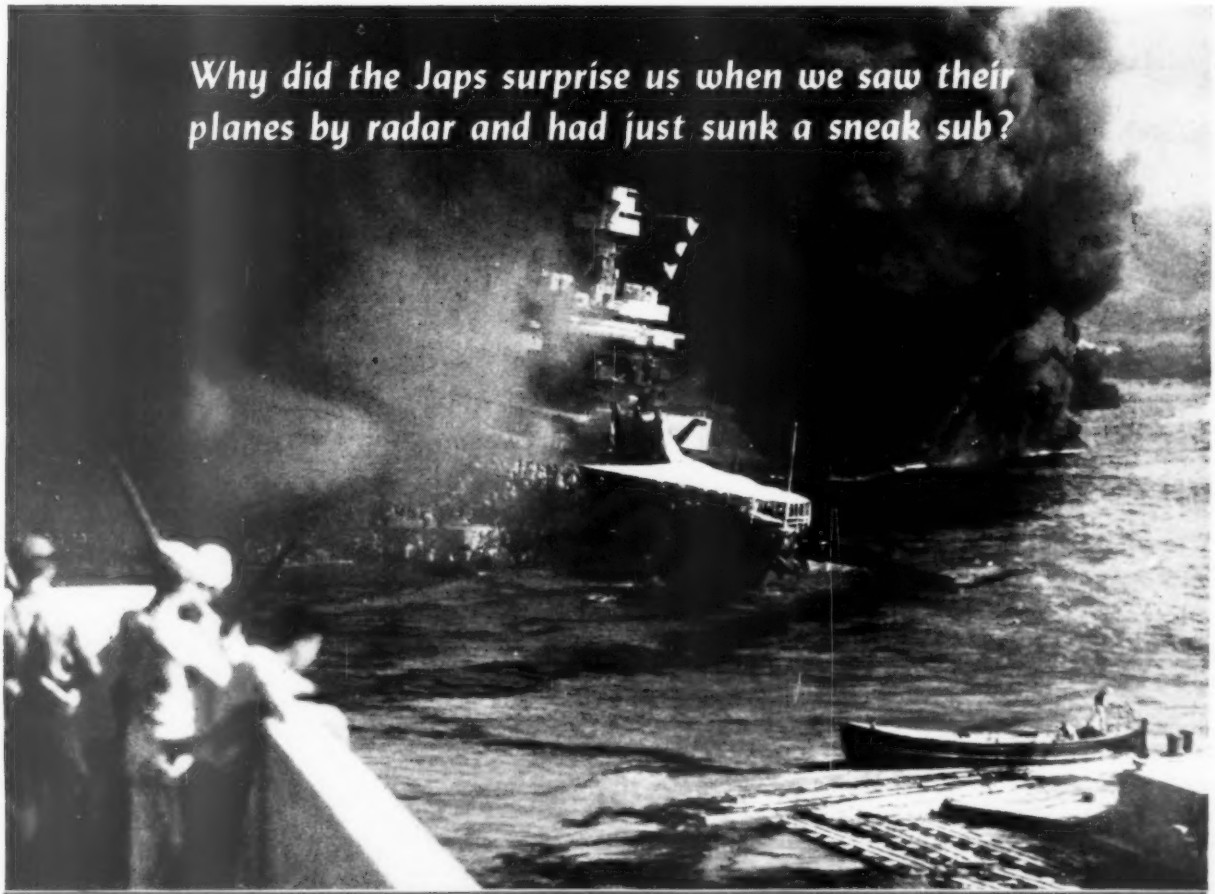
FLYING
JANUARY
1949

THE TRUE STORY OF Pearl Harbor

ON NOVEMBER 26, 1941, a Japanese task force sailed from Hitakappu Bay in the Kurils. The force included, in addition to its train, six aircraft carriers, two battleships, two cruisers, nine destroyers, and three submarines. They reached position approximately 200 miles north of Oahu before dawn on December 7 (Hawaiian time).

Plans for the strike had been initiated during the previous summer, completed by early November. In September picked crews—with pilots who averaged better than 800 hours' flying time—from the Japanese First Air Fleet had begun a period of intensive training in horizontal and dive bombing and in the technique of torpedo attack in shallow waters.

En route to the rendezvous above Oahu, with the ships under radio silence, the pilots were briefed on their coming mission. The primary target was the U. S. naval base



Battleship California sinks at Pearl Harbor and other ships are in flames following Japanese bombing. Note men swarming over the side.

U. S. planes grouped against sabotage were easy targets

What Really Happened At Clark Field?

Our planes in the Philippines had plenty of warning. Yet the Japs destroyed half of them the first day. General MacArthur has been blamed. Who was at fault? Read the answer in next month's issue of FLYING. That story, like this, is condensed from the recently published "The Army Air Forces in World War II", prepared under the editorship of Wesley Frank Craven, New York University, and James Lea Cate, University of Chicago, by the Office of Air Force History. This article is condensed from Chapter 6, by Dr. Richard L. Watson of Duke University. Vol. II of the 7-volume history will appear in May.

of Pearl Harbor, the design to cripple the Pacific Fleet. It was hoped that at least four aircraft carriers and four battleships could be sunk or rendered useless for a long period. Post-war interrogations of enemy personnel indicate a lack of precise information as to the U. S. naval vessels then at Pearl Harbor, but each pilot received charts marking off definite areas of attack.

What were the American air forces the Japanese faced?

Their status, compared with other U.S. overseas garrisons, was relatively imposing. A total of 754 officers and 6,706 enlisted men made up the personnel complement of the Hawaiian Air Force, which was concentrated on the island of Oahu. The force was commanded by Maj. Gen. Frederick L. Martin.

Of the 231 military aircraft assigned to the air force on December 7, approximately half could be considered up-to-date models. Twelve B-17D's, 12 A-20's, 12 P-40-C's, and 87 P-40B's comprised the more modern aircraft, while 33 B-18A's, 39 P-36A's, 14 P-26's, and an assortment of observation, training, and attack planes made up the remainder.

Military and Naval commanders in Hawaii had received warning of an impending break in American and Japanese

Hickham Field burns after surprise attack by Japanese planes December 7, 1941. The first attack began at 7:55 a.m. when 28 bombers in three waves raided buildings and hangar line. Fifteen minutes later, high level bombers attacked, and at 9 a.m. a new wave scored hits.

Boeing B-17 was one of 12 unarmed Fortresses which arrived from U.S. in midst of battle. One was destroyed, three badly damaged.

relations, and forces in the islands had been placed on an alert. The standard operating procedure of the Hawaiian Department outlined three alerts: the first required defense against acts of sabotage and uprising within the islands; the second called for security against attacks from hostile subsurface, surface, and air forces, in addition to defense against acts of sabotage; and the third provided for occupation of all field positions by all units, in preparation for the maximum defense of Oahu and Army installations on outlying islands in the Territory of Hawaii.

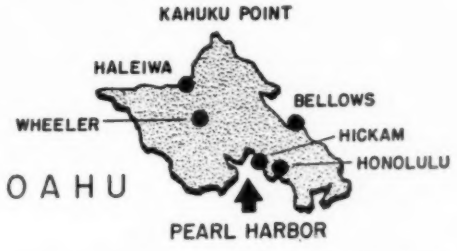
Because a local estimate of the situation indicated that sabotage was more likely than outright attack by hostile forces, the Hawaiian Department ordered Alert No. 1 in operation and notified the War Department of its actions. Aircraft were concentrated in hangars or in open spaces nearby, and extra guards were placed about the aircraft and military installations. Construction was started on protective fencing and floodlighting projects. Of the imminence of hostilities, there was little doubt; but it was generally felt that the most likely area of attack was in the Philippines.

American commanders in the Pacific had received definite warning of an impending break. The War Department on November 27 sent a message regarded as a "final alert" to Army commanding officers in the Philippines, Hawaii, Panama, and the Western Defense Command, which included Alaska, warning them:

> Negotiations with Japan appear to be terminated to all practical purposes with only the barest possibilities that the Japanese government might come back and offer to continue. Japanese future action unpredictable but hostile action possible at any moment. If hostilities cannot, repeat cannot, be avoided the United States desires that Japan commit the first overt act. This policy should not, repeat not, be construed as restricting you to a course of action that might jeopardize your defense. Prior to hostile Japanese action you are directed to undertake such reconnaissance and other measures as you deem necessary but these measures should be carried out so as not, repeat not, to alarm civil population or disclose intent. Report measures taken. Should hostilities occur you will carry out the tasks assigned in RAINBOW 5 so far as they pertain to Japan. Limit dissemination of this highly secret information to minimum essential officers.

Meanwhile the Japanese were already en route to their strike against Pearl Harbor. Exactly on their schedule, at 0600 on December 7, orders for the take-off were given. Shortly thereafter the first wave—50 fighters, 50 horizontal bombers, 40 torpedo bombers, and 50 dive bombers roared off the carriers and headed toward Oahu. Forty-five minutes later 50 horizontal bombers, 80 dive bombers, and 40 fighters followed as the second and last wave of attack. Three hundred sixty Japanese planes participated in all.

The arrival of the first wave over Oahu was not entirely unheralded. About 0630 a small submarine had been sighted in a restricted zone off Pearl Harbor. By 0650 it had been sunk by the U. S. destroyer *Ward*, whose commander had immediately reported the action to the watch officer at the Naval base and had begun a methodical search of the restricted area.



The six radar detector stations of the Hawaiian Interceptor Command had been in operation since 0400; at 0700 they reached the prescribed limit of their regular morning alert. On this occasion, however, the Opana station at Kahuku Point remained open to provide additional instruction for one of the operators. At 0702 the station plotted a group of airplanes at approximately 130 miles, bearing 0° to 3° east of north. This fact was reported by telephone to the information center about 15 minutes later.

Because of the expected arrival of B-17's from the mainland and the probability of search operations by U. S. Naval aircraft, an Air Corps (*Continued on page* 56)

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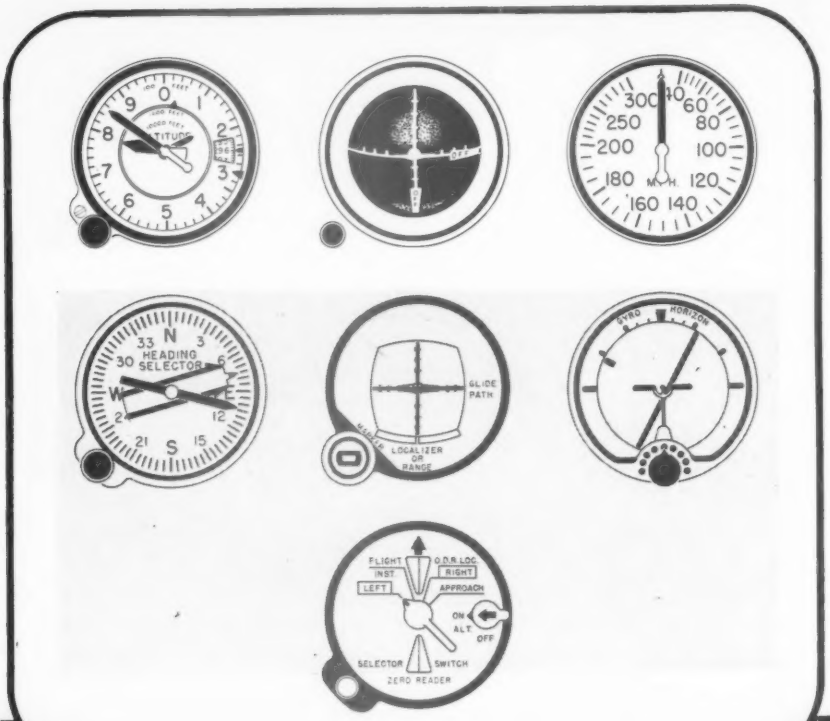


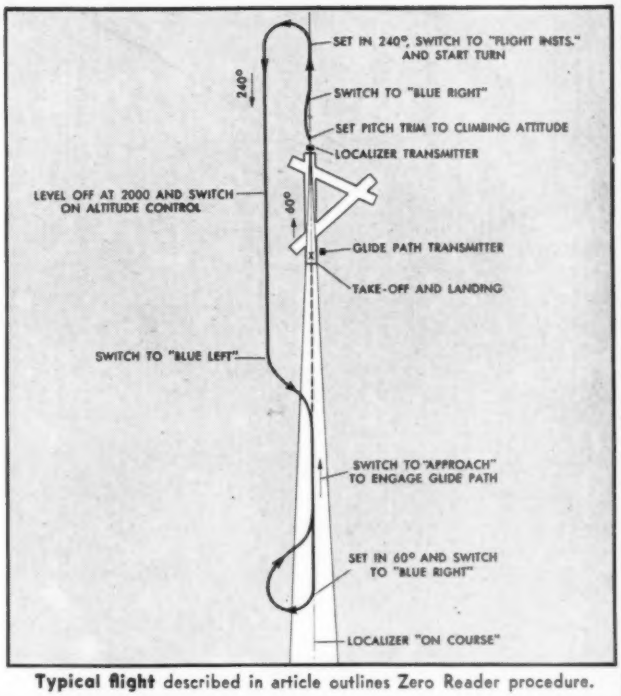
Author's proposed flight instrument panel would be based primarily upon the altimeter, Zero Reader, and airspeed indicator in top row. These are the only instruments he needs for all-weather flying. Other flight instruments in secondary group are primarily for monitoring or standby use. Note Zero Reader heading selector (center row, left) and selector switch (at bottom).

Even inexperienced pilots can now make instrument approaches with revolutionary Zero Reader.

By

CHARLES A. MACATEE

Captain, American Air Lines


SET IN 240°, SWITCH TO "FLIGHT INSTS." AND START TURN
240°
SWITCH TO "BLUE RIGHT"
SET PITCH TRIM TO CLIMBING ATTITUDE
LOCALIZER TRANSMITTER
LEVEL OFF AT 2000 AND SWITCH ON ALTITUDE CONTROL
60°
GLIDE PATH TRANSMITTER
TAKE-OFF AND LANDING
SWITCH TO "BLUE LEFT"
SWITCH TO "APPROACH" TO ENGAGE GLIDE PATH
SET IN 60° AND SWITCH TO "BLUE RIGHT"
LOCALIZER "ON COURSE"

Typical flight described in article outlines Zero Reader procedure.

The Zero Reader - Miracle Navigator

THE ENTIRE aviation industry at this moment is "expecting." However, like many potential mothers, they don't yet know it.

Now this has happened many times before, and the usual thing to do under such fragrant and flagrant circumstances is to sit by the bedside for five to 10 years of labor until, little by little, they begin to feel the pain.

I've got an idea that this baby will be different because it is destined to revolutionize aircraft instrumentation and give pilots a new technique for flying. I hope that aviation, plagued as it is by the weather bugaboo, will rise eagerly to welcome this newcomer.

The word "revolutionary" has been overused in this aviation business of ours, but maybe that description isn't too far off for this new development. It is basically a blind flying and approach instrument. I have found it simple and dependable.

In the many hours I have flown it, an air speed indicator and a sensitive altimeter are *all* the additional flight instruments I have required for flying under instrument conditions.

All this is by way of introducing you to the new brainchild of Sperry Gyroscope Company—the Sperry Zero Reader. In simplest terms, the Zero Reader tells the pilot what to do with the controls in order to stay on a selected flight path without having to resort to a series of mental gymnastics. It automatically pieces together information usually provided by several conventional flight instruments and presents them to the pilot on a simple two-element indicator.

Before I tell you more about this new gimmick, let's take a side glance at aviation again. As an airline pilot I've been right behind home plate watching the curves come in—big beautiful curves in the form of sleek, new aircraft carrying more passengers at greater altitudes and higher speeds. They have super-charging, super-pressurization and hot and cold running stewardesses. In other words, they've got the works. Especially if you take a look at the pilot's compartment. Instruments galore, and very fine ones too. But few of them are much comfort to me when I'm trying to make an approach through a low ceiling and poor visibility.

All this means that aviation can invest in the finest of air frames and the best of power plants and still not dare use them when the weather dictates that they must be kept on the ground. It means that the private flyer may be so affluent that he can afford a flying station wagon yet develop a set of four-ply ulcers watching the fronts go by. All this calls for improved air navigation and all-weather flying techniques. These are impossible without improved instrumentation.

To be sure, improved instrumentation is being made available to the airlines. Many as yet have declined to adopt it. I speak of automatic approach control devices, components of the present-day electronic gyropilot, which provide automatic means for following an ILS flight path through low ceilings and limited visibility. These things really work, and take the curse off of beam following. But the pilot, no matter how enthusiastic he may become about automatic gismos, still wants at hand an equally bona fide, reliable means of taking over manually to accomplish a neat approach through the overcast.

For months during 1948 I have had an opportunity to make many such approaches manually on the Sperry Zero Reader. As experimental pilot for the Air Transport Association, before returning to the line with American, I tested the breadboard version of the Zero Reader aboard ATA's DC-3 airplane, *Beta*. In (*Continued on page* 59)

WILL MISSILES REPLACE FIGHTERS?

Fighters find it increasingly difficult to catch jet bombers. How can they beat them in combat?

By R. G. NAUGLE

BOMBER EXPERT

Richard G. Naugle is a project engineer with the Bomber Branch, Procurement Division, Air Materiel Command at Wright Field. An MIT graduate, he entered aviation with Piper in 1936. In 1938 he formed the Naugle Aircraft Corp., and designed and built the two-place all-metal Mercury lightplane. He has been chief engineer of Waterman Airlines, and an aerodynamicist with McDonnell. The opinions expressed here are the author's and not necessarily those of AMC or Air Force.

Rocket-propelled Me-163 could catch any World War II bomber. Even if future planes keep same speed advantage, can their pilots take it?

ONE of the best ways to start a prolonged, unprofitable, and inconclusive argument is to sit an ex-fighter pilot down into a corner and say rather casually, "Well, I guess you boys won't have anything to do in the next war. The new bombers are a little too fast for your P-shooters."

You then step back as an explosive purple suffuses the countenance of the fighter pilot. After he stops sputtering you broach the subject again—if you dare—and things settle down to a knock-down drag-out "discussion" of the "relative merits."

In case you don't know exactly where to go from here, this is the line of your argument:

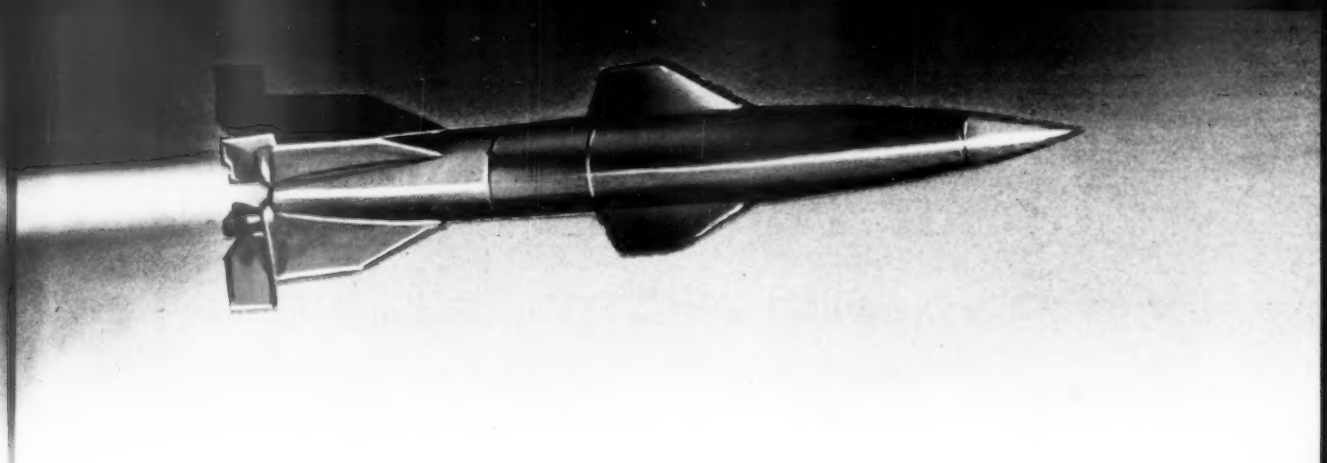
First, there's the much discussed sonic barrier—the speed of sound which so far has effectively limited the tactical speeds of all military aircraft. Second, the development of turbojets has given us more than enough power to push right up to the foot of the barrier. Third, it's just as easy to design a bomber that can skirt the barrier as it is a fighter.

Both can now have the same top speed since both are limited only by compressibility effects. But fighters must *catch* bombers—not just keep up with them! And they have to be considerably faster to do so since they must take off and climb before they can chase and attack.

In the past war our heavy bombers lumbered along at not much more than transport speeds—around 200 m.p.h. while the fighters barreled in at 400+ in their diving passes. Now, however, the jet-bomber can hit 600 just as easily as can the jet fighter—at speeds just below the speed of sound. But they both have to behave.

If the fighter tries to attack by diving from the rear or by any maneuver that involves surpassing his critical Mach number, he'll stumble out of his pass from compressibility effects and "go on down" and out of the fight. The bomber, meanwhile, just sits tight, covers him with his radar-aimed, remotely controlled rear turrets and watches the red line on his Machmeter.

The bomber, then, has little to fear from his once vulnerable rear, and a head-on, one-pass "collision" attack from the front at a combined speed of well over 1,000



Flying bombs can be guided to their targets by homing devices or by direct guidance. Here, a U.S. Air Force operator is directing a flying missile by remote radio control (note controls at his finger tips) while he watches its progress by television contained in the bomb's nose.

m.p.h. can't hope to be successful.

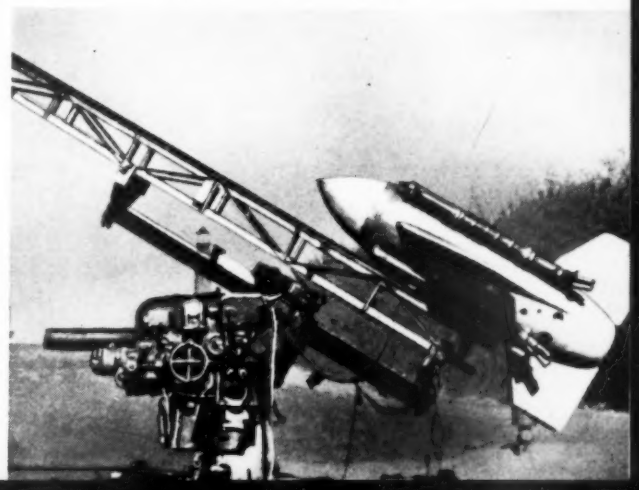
The idea of unstoppable bombers, coming in high over the target at speeds just below the speed of sound, without escorts and in full daylight, is now a cold fact that scrambles the entire picture of air power and explains the absolute necessity of perfecting some sort of supersonic defensive device—manned fighters, supersonic missiles, or what have you? Otherwise we are confronted with the deadly combination of unstoppable bombers and the atomic bomb!

Powerful turbojets, allowing exceptionally clean aerodynamic design, are responsible for this dilemma. Nowadays the bombers too can have sweptback laminar-flow wings, needle-like fuselages, small tear-drop canopies, and buried guns. In fact, jet-bombers are nothing more than grown-up fighters as far as external shape and appearance goes.

The Boeing B-47's 45° of wing sweep, and the North American F-86's 36°, for example, allow level flight Mach numbers of about 0.95—and the latter has surpassed Mach 1.0 in a dive. Both are in the 600-700 m.p.h. class—only a gnat's eyelash from the speed of sound.

Until supersonic flight becomes tactically feasible the compressibility wall can be used as a defensive weapon by bombers to protect themselves on end-runs into the target zone. Consequently, the barrier *must* be conquered and eliminated. If we can't have supersonic fighters then we must have supersonic guided-missiles. We have supersonic research missiles and we have supersonic research planes now, of course. But will the Navy missile men at Inyokern and those of the Air Force at Alamogordo outrace the fighter boys at Muroc and Eglin Field? The technical problems of supersonic flight are fantastically more complicated when man (*Continued on page* 72)

German Enzian ground-to-air missile is a scaled-down version of t
Me-163. It was propelled by rocket power and launched from firing ram



Atomic Engines For Aircraft

Supersonic bombers capable of flying non-stop around the world seem definitely on the way.

By ANDREW KALITINSKY

Cutaway Drawings by Douglas Rolfe

ATOMIC energy promises to power airplanes combining extremely high speed and almost unlimited range. The application of nuclear energy may eventually make possible a supersonic bomber capable of flying around the world without pausing to refuel.

We have not manufactured an atomic power plant for aircraft, but we can say now that the practical development of atomic energy as a source of power calls not so much for new discoveries as for a great deal of engineering work. The practical use of atomic power can become a reality if physicists, engineers and industry take an increasingly active part in its development.

There are definite limitations on the possible performance of chemically fueled aircraft, since the required gross weight of the plane increases with both range and speed. For a given speed the required gross weight increases rapidly with range as the amount of required fuel increases. If we try to design an airplane of greater range at this given speed, we cannot do it no matter how large a plane we select. As the airplane speed is increased, the gross weight for any selected range rises. Even more important, the maximum range that can be achieved decreases as the airplane's speed increases.

Because of this limitation on the speed-range performance of chemically fueled planes (this includes jets), we must find a new fuel. Our present supersonic airplanes run out of fuel in a matter of a few minutes. With atomic energy, they could keep on going, for the aircraft's fuel supply would remain nearly constant.

Several basic types of power plants can be adapted to utilize atomic power for the propulsion of aircraft. They are all thermal power plants, since fission energy is released mostly in the form of heat.

Atomic Physicist

Andrew Kalitinsky, at 34, is chief engineer of Fairchild's NEPA (Nuclear Energy for the Propulsion of Aircraft) Division. This article is reprinted from The Pegasus, a magazine published by Fairchild.

One example of a thermal power plant which could be used with atomic fuel is *the closed-cycle turbine*. It may be a steam or mercury turbine. Steam is generated in the nuclear reactor by the heat released there. The reactor therefore replaces the boiler of a conventional power plant. The steam expands through the turbine, which drives the propeller. The steam is then condensed in an air-cooled condenser and is forced back into the boiler-reactor by a feed pump. This type of power plant requires the use of both a propeller and an air-cooled condenser, which will evidently limit the airplane speed at which it can be used. For that reason it does not appear as practical as other possible applications.

Another application of atomic energy is in the *turbo-jet*. What is done here is simply to remove the combustion chamber of the conventional turbo-jet and replace it with a nuclear reactor. Air is compressed and forced through the reactor, where it is heated by convection instead of by combustion of fuel. It then expands partially in the turbine, enough to provide sufficient power to drive the compressor, and finally in the jet nozzle where it creates propulsive thrust. This type of power plant is very well suited to high-speed airplanes.

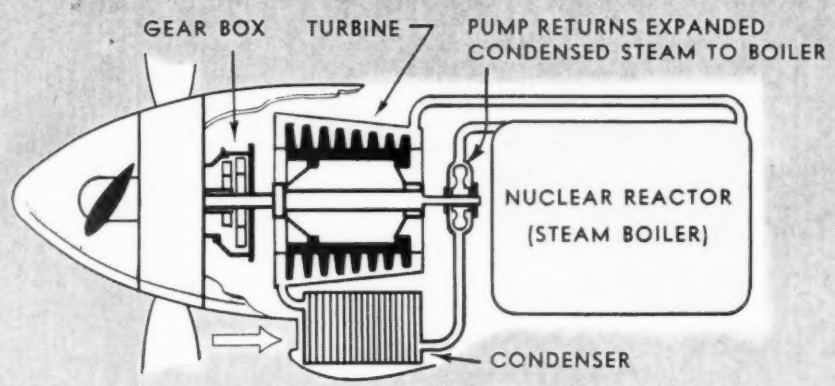
On paper, the *ram-jet* is the simplest type of power plant conceivable. Air enters the diffuser at the front end of the engine and is compressed by the forward speed of the plane. It then passes through the nuclear reactor, where it is heated to a high temperature, and goes into the exhaust nozzle, where it expands and acquires a high velocity to provide thrust. The ram-jet requires a high flight speed to function at all and becomes really effective at extreme speeds high in the supersonic region. The air temperatures required by the ram-jet are very high, considerably higher than those needed by the turbo-jet. At the same time, the ram-jet is very sensitive to pressure drops caused by the internal flow resistance of the reactor or combustion chamber. Good heat transfer conditions must always be paid for by appreciable pressure drops. The ram-jet is therefore not quite the simple problem it appears to be at first glance.

In the application of nuclear energy to a *rocket*, a propellant (liquid hydrogen, for example) is pumped out of the tank and through the reactor, where it is vaporized and heated to a high temperature. It then escapes at high velocity through the exhaust nozzle. The rocket is driven by the recoil of the escaping propellant and thus is not dependent on atmospheric air for its functioning. It can, therefore, operate outside the earth's atmosphere.

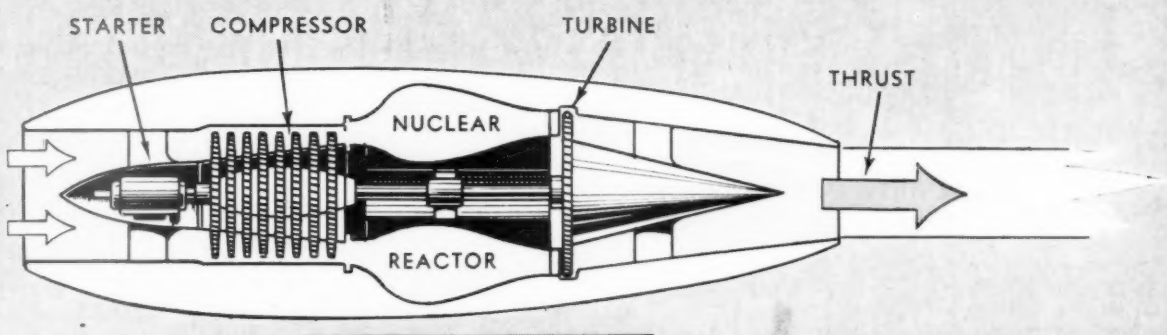
One may well ask where the advantage lies in using nuclear energy for rockets, since their endurance is limited and they can operate only until the fuel is exhausted, regardless of the practically unlimited supply of energy in the reactor. Nuclear energy offers a definite advantage in rockets because the maximum impulse, the pounds of thrust that can be obtained from each pound of fuel used per second, results from a combination of the highest temperature and the lowest molecular weight of fuel.

The high temperature is obtained normally in a chemical rocket by the combustion of a fuel and an oxidizer, whose products of combustion (*Continued on page* 52)

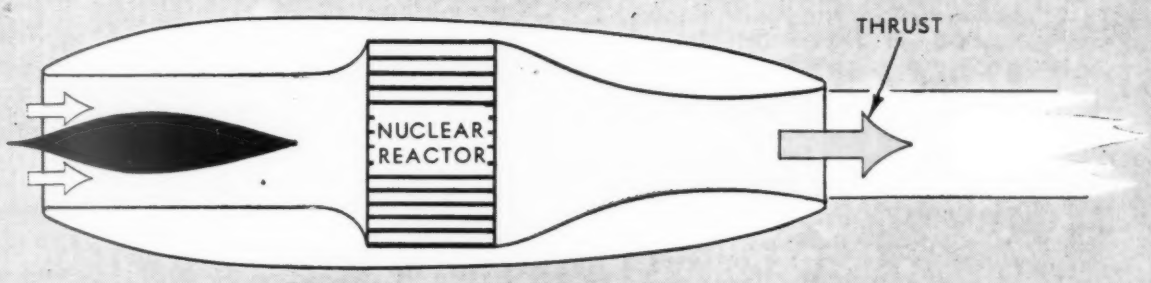
FOUR POTENTIAL TYPES OF ATOMIC ENGINES



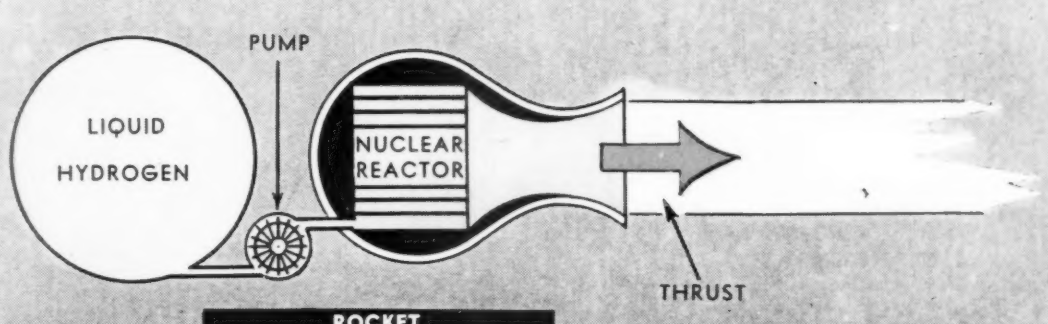
CLOSED-CYCLE TURBINE



TURBO-JET



RAM-JET



ROCKET

Jet-Propelled Lightplane

By Hugh G. Nicholson, Jr.
AS TOLD TO TOM ENGELMAN

ABOUT THE AUTHOR

Hugh G. Nicholson, Jr., is an aviation industry veteran. He has worked for major aircraft companies, including helicopter manufacturers, in a variety of engineering jobs ranging from preliminary design to test pilot. As head of Nicholson Aircraft Corporation several years ago, he built two high-performance personal airplanes. He is now director of training for Cal-Aero Technical Institute, at Glendale, California.

You may be flying that jet two-placer sooner than you think.

IMAGINE picking up the morning paper to read "Mr. and Mrs. Robert Smith arrived at Kansas City Municipal Airport today after a 1 hr. 37 min. flight from Chicago in their private plane." Such stories will someday be commonplace if students at Cal-Aero Technical Institute, Glendale, Calif., have their way. They are building a jet personal aircraft which will enable private pilots to fly cross-country at airliner speed.

Through simplified construction and use of an unusual low-cost engine, the builders believe they can insure a low purchase price and maintenance cost for purchasers of the jet personal plane.

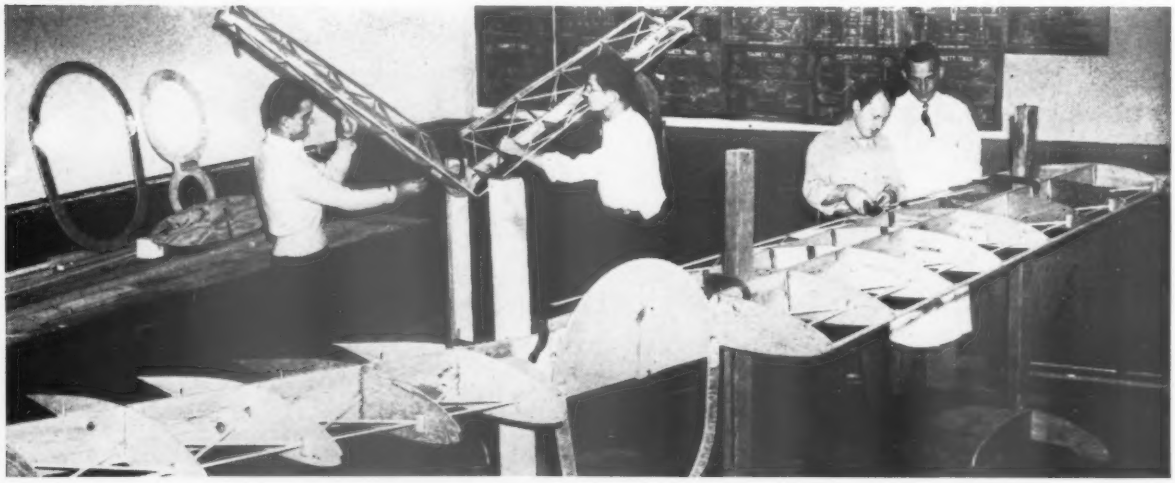
A single-place experimental model of the projected two-passenger craft is now being fabricated in the Cal-Aero shops—as is a compact 240-lb. thrust jet engine, developed almost entirely from surplus and other available standard units.

Designated the XLC-1, the research plane's wing span is only 20 ft. 10 in. and overall length is 17 ft. 1 in. Because of the jet engine, which eliminates the need for prop clearance, height is just 5 ft. 11 in. Gross weight is 1,278 pounds.

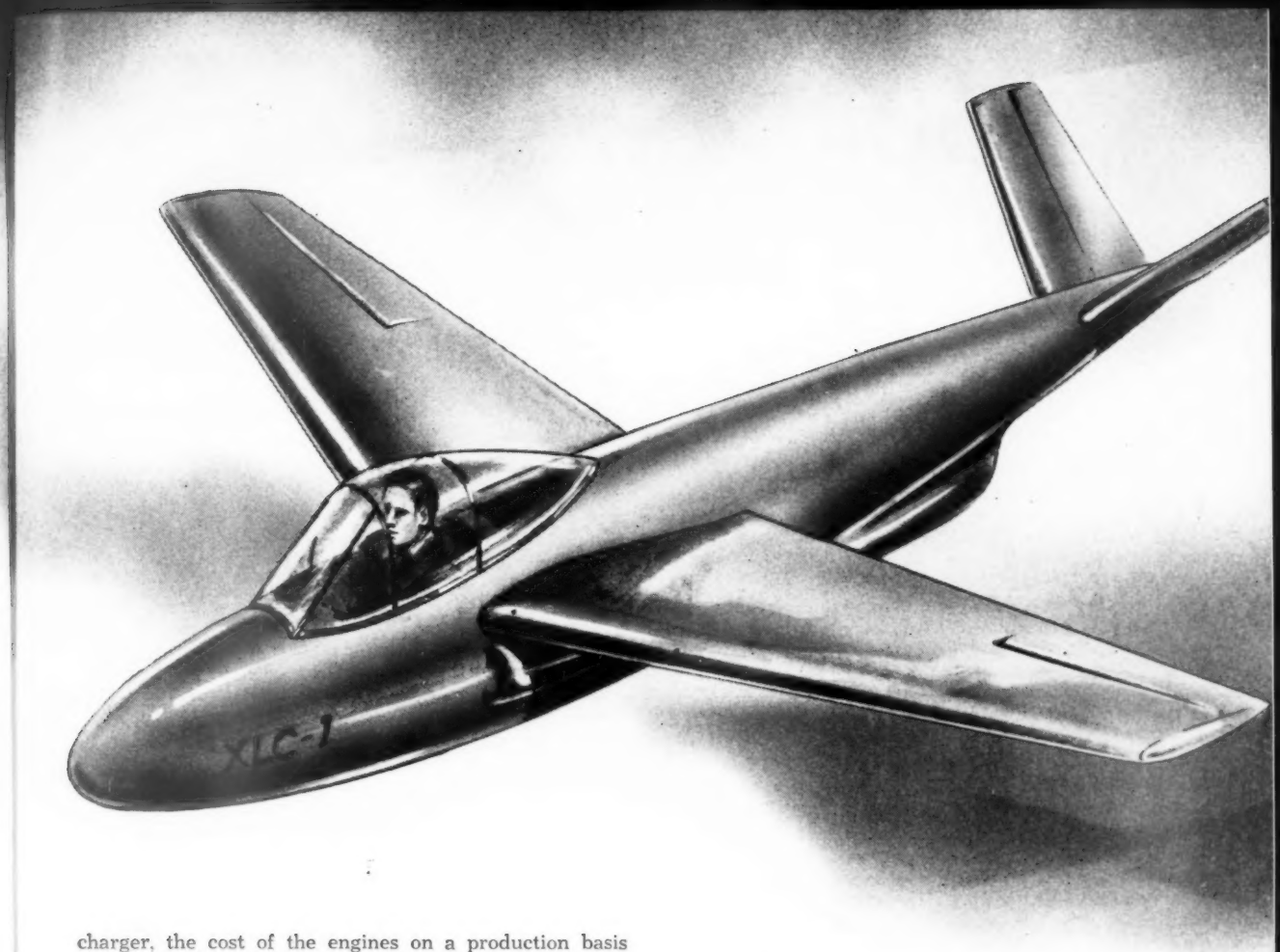
The all-metal plane has a high double-taper midwing and a "butterfly" tail assembly similar to the Beech *Bonanza*. Air intakes for the engine are located alongside the fuselage with the jet exhaust under the fuselage, just forward of the tail assembly.

Landing gear is "bicycle" type, the two main wheels in tandem in the fuselage, with outrigger wheels on the wing for ground handling. The fuselage rests less than a foot from the ground, making entry to the cockpit easy.

The jet engine around which the diminutive plane has been designed is the result of almost four years research at Cal-Aero. Developed from a type "B" surplus super-



Mock-up of the jet plane is nearing completion. Here, Cal-Aero students apply the finishing touches to wing and tail mock-up structures.

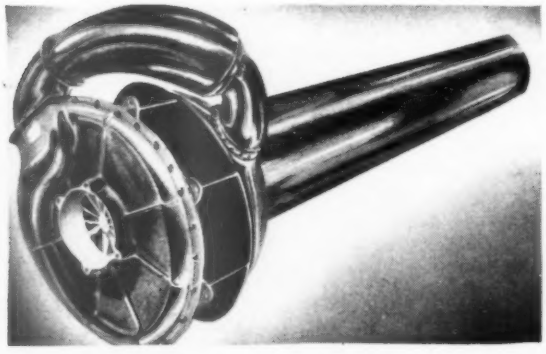


charger, the cost of the engines on a production basis would be extremely low in comparison with reciprocating types of substantially smaller horsepower.

The latest in a series of similar jet powerplants, the engine promises to possess unusual endurance qualities. Should the engine be certificated for production, one of the current stumbling blocks in the reduction of the initial cost of personal aircraft—that of high engine costs—would be overcome.

Original idea for the design came from William Laxson and Bob Cameron, engineering (*Continued on page* 71)

All-metal jet with butterfly tail will fly 250 m.p.h. on engine made from surplus supercharger, designers claim. Estimated range is 325 miles.



Compact turbo-jet (above) which will power the Cal-Aero plane is built around a type "B" supercharger. The engine is capable of developing 240-pound thrust. Right, staff members confer on prototype. From left, Sal Cardinale, chief aerodynamicist; John Dickinson, chief engineer; James Wilson, power plant research head; Nicholson, director of training at Institute; and Dick Kellner, an assistant.

YOUR JOB in *Aviation*

★ A LONG-RANGE FORECAST OF AVIATION EMPLOYMENT ★

IF YOU want the right job in aviation, you can probably get it within the next year or so—provided you have the qualifications.

The aviation job lull, in aircraft manufacturing in particular, is apparently over. Factory employment gains especially are certain in the immediate future.

Thousands of positions should be available each year indefinitely. This will be true even after the immediate phase of the 70-group Air Force expansion program is achieved. Rising plané output during the next two or three years is a virtual certainty. The likelihood is great for a fairly stable high peacetime level of production thereafter.

These conclusions were reached by the Bureau of Labor Statistics' Occupational Outlook Service after extensive research into the aviation industry today.

If you want to be an aircraft mechanic, stock and stores clerk, or a steward or stewardess, your chances for finding a job are fairly good, notably over the longer run. Ground radio operators and teletypists are needed today outside the U.S., but only a very slight upswing is foreseen in jobs for dispatchers and assistants and in the meteorology field. Demand for pilots will be moderate, and slightly rising employment is expected in the limited flight engineer occupation. In traffic work too, opportunities will slowly increase in number each year as time goes on.

In aircraft plants alone, including parts and engine establishments, a new peacetime peak reaching possibly half a million workers is strongly indicated for shortly after the turn of the decade.

It is especially important for persons interested in aviation, and for persons planning to enter the field, to understand the full possibilities of particular jobs. The following information on specific occupational groups in air transportation represents the latest word of the Bureau of Labor Statistics' Occupational Outlook Service on employment prospects in these fields.

By HERMAN B. BYER

Acting chief, Division of Employment and Occupational Outlook, Bureau of Labor Statistics, Herman Byer has been a Government official since 1919. He is the originator of several recognized methods for estimating employment trends. An Infantry veteran of World War I, Byer is a graduate of the University of West Virginia.

PILOTS

● *Demand will be moderate.*

The net increase in number of employed commercial pilots during any one of the next two or three years will probably not exceed a few hundred at best.

Considerable competition for pilot jobs is anticipated for some years. Although only a small proportion of wartime military pilots have sought flying jobs, applications from veterans still have been much greater than the

NAVIGATORS may find it harder to get jobs. Field is small, and newcomers will have few job chances in immediate future. Use of radar may cut need for navigators.

STOCK CLERKS are in demand. Employment of stores and stock clerks may double in next five years. Work is easy, pleasant. Entrance into the occupation is easy.

GROUND RADIO OPERATORS and teletypists can get foreign jobs. In the near future a slight employment rise is seen. Need is now greater for teletypists.

MECHANICS have top job chances today. Hiring will soon become heavy enough to diminish greatly—possibly even to wipe out—the surplus of applicants.

PILOTS will encounter considerable competition in the job market for some years. Even highly-qualified applicants will outnumber vacancies for several more years.

STEWARDESSES and stewards will be hired in increasing numbers. Assuming continued high business levels, the number of jobs will jump sharply in future.

number of openings—and other men with flight training and experience are in the market for the same jobs. CAA commercial license approvals have dropped sharply since the first post-war year, but the number getting these ratings is still far greater than the number of openings. Even highly-qualified applicants will be more numerous than vacancies for a year or two—and probably longer.

On the other hand, it seems likely that airlines will want some of their co-pilots to act also as flight engineers (United Air Lines has already announced such a plan). Such experience and service may become a condition to advancement to captain. That considerably improves the job chances and the opportunity for promotion of pilots who also can qualify as flight engineers.

The fact remains, however, that men with no flying history will have difficulty getting into the field for several years at least. The Air Force's 70-group program and the draft will not significantly alter the picture.

FLIGHT ENGINEERS

● *Small field, rising employment.*

Employment will rise somewhat over the years with increased use of larger planes and longer non-stop flights. Federal action (such as recent CAA and CAB rulings requiring a flight engineer on all aircraft over certain gross weights) may tend to increase employment. On the other hand, as indicated above, some qualifying co-pilots may be doing work which would otherwise be handled by a separate flight engineer added to the crew. In some instances this may mean the substitution of a pilot-engineer for an engineer. In any event, the field will remain small. At war's end there were only a few hundred men working as flight engineers. The field at present is only slightly larger.

In contrast, thousands of candidates are certain to apply for jobs—first, from among the airlines' ground maintenance staffs; second, from among the great numbers of former flight engineers and ground mechanics of the Air Force and Navy. There is today an oversupply of qualified applicants for flight engineer positions, and the condition is likely to persist indefinitely. Federal flight engineer regulations, the planned Air Force expansion, and the draft will only slightly reduce this surplus.

NAVIGATORS

● *Long-range decline.*

This is a small field. In early 1948 employment was no more than two or three hundred. Expanding overseas airline operations and other developments may lead to some openings, especially if general business activity remains at high levels. But employment is not likely to increase as rapidly in this occupation as in most other airline jobs.

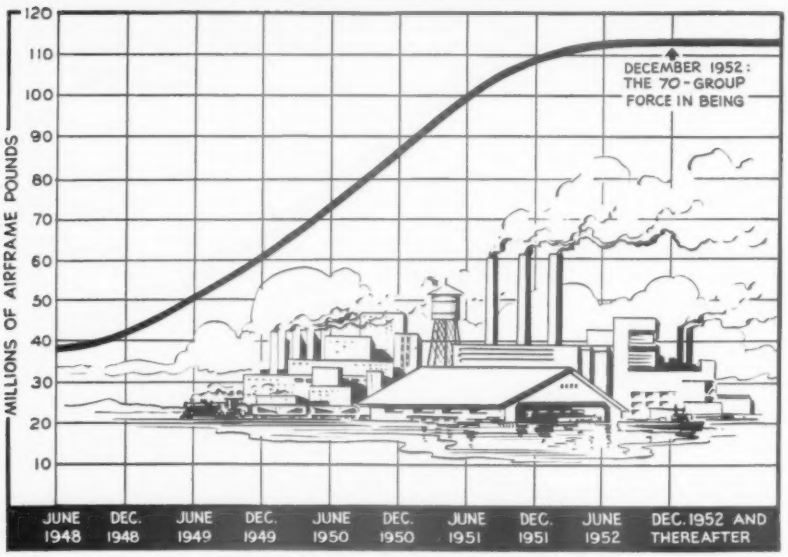
In the long run, employment of navigators will probably decline. Technological and other factors may cause the elimination of these flight crew members on an increasing number of routes. There is, for example, continued demand for international airways with radio-range beams and other navigation aids similar to those which are now in use on domestic airways. The in-

METEOROLOGISTS can expect a slight upswing in employment prospects. Even now, a shortage of adequately-trained men is found. Field is not overcrowded.

FLIGHT ENGINEERS will be required in larger numbers on airlines but an oversupply of experienced, qualified applicants is expected to persist indefinitely.

TRAFFIC AGENTS and clerks are in a growing field. The largest number of openings will probably be for reservation and traffic clerks on the airlines.

U.S. PRODUCTION WILL RISE



Airframe production in 1952 will be about three times the 1948 rate, experts believe. To build and maintain the 70-Group Air Force in being, thousands of men will be hired.

creasing use of radar in civilian aviation may also make navigators unnecessary on a growing number of flights.

Under the best conditions foreseeable, it is likely to be difficult even for experienced men to obtain navigator positions. At the beginning of this past year, the airlines had many furloughed navigators with first claim on any openings. In addition, applicants with navigator experience in the armed forces have tended to outnumber openings, though only a small percentage of former armed service navigators have sought civilian jobs in the occupation. Newcomers have practically no chance for positions. This will certainly continue to be the case for several more years at least. The oversupply may grow, despite the 70-group program and the draft.

FLIGHT RADIO OPERATORS

● *Overcrowded field.*

The outlook for jobs as flight radio operators is similar to that for navigators, with employment not likely to increase much between now and 1950, and with only a few openings because of turn-over. Employed operators number about the same as navigators, and the number employed may not rise as fast as airline jobs generally. They may even decrease.

Among factors which will tend to keep down the number of flight radio operators are:

(1) Prospective establishment of more international airways with radio-range beams and other navigation aids.

(2) Increasing use of radar for civil air transportation.

On the other hand, great consideration will always have to be given to adequate ground maintenance, servicing and repair of whatever electronic equipment is used on planes. It is more accurate, however, to view this as a factor relating to substitute employment rather than one affecting the employment situation of flight-radio operators as such.

First in line for future vacancies are experienced operators now on furlough from airlines. Next come ground radio operators who are eligible for promotion. In addition, some wartime armed service flight radio operators continue to seek comparable civilian jobs. Persons trained for other kinds of radio-operator work constitute another potential group of eligibles. All in all, more interested and qualified men are available than there are job opportunities. Newcomers have practically no chance for employment. This will continue to be the picture for some time to come, but qualified men may be able to compete successfully for jobs in a great variety of expanding fields, aeronautical and otherwise.

STEWARDS AND STEWARDESSES

● *Job prospects favorable.*

The high turn-over rate, combined with steadily-increasing need for hostesses and stewards, make the job prospects in this field more favorable than in most other aviation occupations. Employment is now much higher than at war's end, when stewardesses and stewards together numbered upwards of only 1,000 with the latter accounting for only a small fraction of the total. Since VJ-day, several thousand new hostesses and perhaps two or three thousand new stewards have been hired—to meet demands of the rapidly-growing trans-oceanic and intercontinental traffic, to staff the many additional and larger planes now in service, and to fill vacancies due to turn-over.

Replacement needs have always been heavy, especially among hostesses, because of the post-war high marriage rates and the availability of other jobs. Post-war changes in policy respecting the use of stewards in domestic operations have resulted in their making up a greater number of the total persons employed. Assuming continued high levels of general business activity, stewardess and steward jobs may aggregate 6,000 by 1950—an increase of roughly 50 per cent in close to three years.

Recent furloughs, though temporary in character, will have only a slight effect on job chances for newcomers, even in the immediate future. Competition for jobs is likely to be keen, however. Despite strict hiring standards, interest in the occupations is so great that there are practically always qualified applicants competing for positions.

In the long run, job prospects are good.

DISPATCHERS AND ASSISTANTS

● *Slowly rising employment.*

A gradual rise in employment is expected in the near future and over the long run, provided general business conditions are good. Even so, this occupation will number only in the hundreds for many years.

In the past, most vacancies have been filled by promotion or transfer from within the organizations. Grounded pilots, in particular, should be increasingly moved into dispatcher positions. When outsiders have been desired as assistants, employers have had more than enough qualified applicants. The potential number of such job-seekers (from among Air Force operations officers and pilots, for example) is so great that employment chances for outsiders are almost certain to remain poor indefinitely.

METEOROLOGISTS

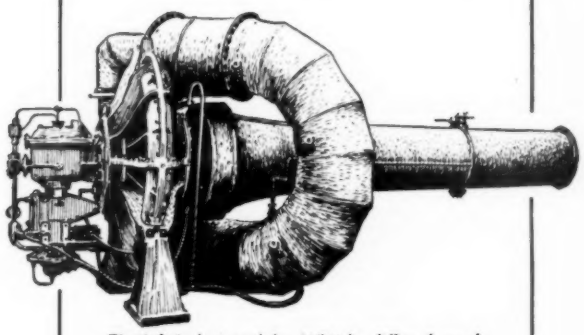
● *Slight upswing.*

Airline meteorologists make up the smallest of the groups discussed in this article. (*Continued on page* 61)

Daring Young GENIUS of JET PROPULSION

By J. P. McEVOY

Frank Whittle battled odds after experts said he was 'impractical.'



First jet designed by Whittle differed much from the giant, powerful models in use today.

ASHY, inventive genius named Sir Frank Whittle is the father of jet aircraft. How delighted the traditionally reserved English feel about Whittle's contribution to his country's air power is evidenced by the fact that they have knighted him and given him an outright grant of 100,000 pounds (about $400,000) tax free—the biggest reward ever bestowed by Great Britain on an inventor.

All of the jet planes which are now chasing propeller-driven planes out of the air (the U. S. alone has about 50 different jet models flying or in development) have one thing in common—they are descendants of Whittle's first successful jet engine. The "W 1" (W for Whittle) powered the Gloster Whittle "E/28/39" on the first historic jet flights in May, 1941.

Though Whittle is painfully shy, his career has been one of daring and defiance. At 15 his future hinged upon a successful rebellion against Royal Air Force regulations. Applying for admission to the RAF apprentice school, he passed his written examination only to be rejected by the authorities on physical grounds—"too short, too small, too puny" ever to make an airman.

"I went to a sympathetic physical instructor," says Whittle, "who prescribed building-up exercises and a diet that seemed mostly olive oil. In a few months I had put three inches on my height, three on my chest—you grow fast at that age—and was ready for another try. Although warned that once rejected physically I wouldn't get another chance, I took the written examination again anyway and another physical—carefully neglecting to tell the authorities this was the second time—and passed."

At 16 Whittle was an RAF apprentice, learning to repair and service airplanes. Three years of this and he was awarded a cadetship—one of six students out of 600 to make the grade. When he was graduated as a flight cadet at 21, his precocious thesis was: "The Future Development of Aircraft," with a discussion of the possibilities of jet propulsion. This in 1928, when such an idea was not only visionary but preposterous.

"It was 18 months later," says Whittle, "that I conceived the idea of a gas turbine for jet propulsion—the first time, to my knowledge, that this combination was ever thought of. This turned out to be the basis of the successful jet engine we developed later. I applied for my first patent in January, 1930, and submitted the idea to the Air Ministry, but was turned down on the grounds that it was impractical. I then tried to interest various firms, with no success. For five years I continued my paper work, but getting the financial backing to build my engine looked so hopeless I allowed the original patent to lapse." (Later Whittle took out the subsidiary patents which he turned over to the British Government and which are now reaping millions of pounds and hard dollars in royalties for the British Treasury.)

Today, Whittle says there was mighty good reason for the Air Ministry and others to (*Continued on page* 48)

Sir Frank Whittle (seated) is known as The Father of Jet Aircraft. Whittle's ideas were considered "preposterous" in 1928, Author J. P. McEvoy (right) recalls.

EFFICIENCY RACE

Wings Field Regatta helps develop amazingly economical lightplane cruising techniques.

Gene Simonin, who piloted first plane to finish, steps from Beech Bonanza. Simonin had best time score in class with 140.2 m.p.h., but used most fuel, hence ended up in seventh place.

SEVENTY-ONE PILOTS got a first-hand lesson on how to squeeze the last mile out of their gasoline at Wings Field, Ambler, Pa., one Indian Summer day last October. The occasion was the annual fall regatta of the Philadelphia Aviation Country Club, and the lessons of the regatta merit the study of pilots and fixed-base operators throughout the country.

The pilots can learn more about cruise control techniques applied to lightplanes. The operators can learn about an entirely new type of pilot participation event that ought to increase interest of airport customers.

The regattas are really efficiency races in which planes of the same make and horsepower are pitted against each other over a carefully measured cross-country course. But unlike other airplane races, minimum gasoline consumption is given exactly as many points as maximum speed.

More than 300 pilots and guests from 14 states, including persons from points as far distant as Florida and Texas, attended the fall regatta at Wings Field. It was the fourth and largest conducted there by Tony Little, originator of the event, since World War II. The course was 218 miles.

In these regattas, the airplanes compete only against others of the same make and horsepower. All of these similar planes are grouped together into a "class." Crews must consist of at least two persons.

Planes completing first lap of efficiency race fly past Philadelphia Aviation Country Club, which sponsored the lightplane regatta.

Winners are determined by combining speed points and fuel consumption points. Speed points are determined as follows: Multiply the least elapsed time by 100. Divide the total by the elapsed time of the individual contestant. Then divide by two. Points for fuel are determined by multiplying the least fuel consumed by 100 and dividing by the fuel consumption of the contestant. Then divide again by two.

If you like mathematics, here are the formulae:

$$\text{Speed points} = \tfrac{1}{2}\,\frac{100 \times \text{least elapsed time}}{\text{elapsed time of contestant}}$$

$$\text{Fuel points} = \tfrac{1}{2}\,\frac{100 \times \text{least fuel consumed}}{\text{fuel consumption of contestant}}$$

The total is the sum of the two scores.

Here's the way this works out in actual practice. Max Karant of AOPA won first place in the *Ercoupe* class with 98.7 points—compared with 90.1 points for second-place winner W. N. Lawson. Yet Lawson's average speed of 95.4 m.p.h. was more than Karant's average of 93.0 m.p.h. Karant won because he burned only 9.4 gallons of fuel compared with 11.7 for Lawson.

Karant's gas score, since it was the best in the class, was the yardstick against which all other participants in the class were measured. With the formula, it works out to be 50. To determine Lawson's gas score, let's see how the formula applies. One hundred times Karant's gas score of 9.4 gallons is 940. Divided by Lawson's gas score of 11.7 gallons consumed, the result is 80.3. Again divided by two, it is 40.1—the final score allotted to Lawson for gas.

Since Lawson had the best time, he received 50 for his time score—or a total of 40.1 for gas plus 50 for time, or 90.1. Karant had only third best time, but his time score, using the formula, was 48.7. This, added to his gas score of 50, provided a total of 98.7—considerably above any other pilots in the class. All scores are worked out by the same method.

This fourth Wings Field Regatta showed up a serious discrepancy in the scoring method, particularly for larger airplanes. The pilots decided that more points could be scored on gas than on speed, and accordingly throttled back to minimum cruising speed. This loophole in the formula had not become apparent in previous regatta results, but appeared for the first time in the Allentown Regatta held the previous week. Many of the pilots at the Wings Field affair had flown at Allentown the week before and learned that fuel economy was the secret of winning. The results of this factor, however, do not show up as markedly in the Piper *Family Cruiser*, Cessna 120-140 classes, and so on, as in the higher-powered airplane classes.

The average speed of the (*Continued on page* 67)

WINNERS — FALL AIR REGATTA

Pilot	Class	Gasoline Consumed	Gal. Hr.	Mi. Gal.	M. P. H.	Gas Score	Time Score	Total Score
J. M. Arner	Beech **Bonanza**	7.25	3.8	30.0	114.7	50.0	40.7	90.7
A. Smolinski	Cessna 120-140	10.2	4.7	21.4	100.0	49.5	48.8	98.3
Genevieve Wadhams	Cessna 170	9.7	4.4	22.5	98.6	50.0	42.5	92.5
J. G. Keaveny	Bellanca **Cruisair**	15.5	10.2	14.1	143.0	46.3	50.0	96.3
Max Karant	**Ercoupe**	9.4	4.1	23.2	93.0	50.0	48.7	98.7
D. Pinelli	Luscombe **Silvaire**	8.8	3.5	24.8	85.6	50.0	46.9	96.9
W. E. Wells	**Navion**	12.5	6.6	17.4	113.8	50.0	46.2	96.2
E. Braden	Piper **Family Cruiser**	12.3	5.5	17.7	96.1	50.0	48.8	98.8
J. T. McLamore	Stinson **Voyager**	17.5	9.0	12.5	111.3	50.0	49.8	99.8
A. C. Croff	**Swift**	11.9	6.5	18.3	118.3	50.0	49.8	99.8

The Air Force Moves On Its Feet

Tons of bombs are carried in one B-29—on a single raid. Before an Air Force can conduct large-scale attacks, it must provide supplies.

Before a single bomber can take off in combat, the AF must transport thousands of soldiers, tons of materiel.

By Col. F. X. PURCELL, Jr.
United States Air Force

HAVE YOU ever observed an expert fencer, and noticed what he does with his eyes? He is usually looking down and you may think that he is watching his opponent's foil. It is worth watching, as it presses deceptively against his, then disengages, slithers in and out like a snake, feinting and withdrawing, seeking a place to strike.

But if your fencer is watching that, it is only coincidental. He can feel where his opponent's blade is, and as long as he can keep in touch with it he isn't worried. What he is watching is his opponent's foot.

The reason is that his opponent can't reach him with a dangerous thrust without moving his whole body forward on his feet. The move may be quick and stealthy, and when it comes he must parry, but in the meantime he need only plan his own attack, and watch that foot.

The airplane is the foil of the Air Force. It is the part that strikes. The rest of the Air Force is the body. Before the airplane can make an effective thrust, that body must move. A handful of bombers on a "training flight" or a "good-will tour" may make a ripple in the confused waters of popular fancy but it will not impress the military leaders of a great power. They are watching our foot.

Then what is this body of the Air Force which must move forward before we can strike?

To understand that, we must get into the "numbers racket," the process by which the armed forces arrive at those staggering figures they present to the Congress and the press. One personnel officer explains it this way.

Suppose we put 100 men on an uninhabited island in the middle of the Pacific with the job of *doing absolutely nothing*. Well, first of all they must be fed. So we have to provide cooks, KP's and a mess sergeant on the basis

Before an invasion, vast amounts of material are stockpiled.

Transport ships by hundreds are needed to supply vital bases.

of about 1 to 10. That brings our force of 100 up to 110. Then there is the guard, and to keep it small, let us have just one post with three reliefs and a commander. Since they have to rest on alternate days, there must be two complete guards for a total of eight men. That gives us 118 on the island.

Now even by just sitting, these men will wear out the seat of their pants; also, the kitchen must be provided with food, fuel, cooks' clothes and utensils, and the guard with arms and ammunition, and so forth. So we need a supply sergeant, with some assistants to man-handle the supplies and drive and maintain the supply truck. Say an additional four, making 122 in all.

These men, you remember, are on an otherwise uninhabited island and some of them will get sick or have a toothache from time to time. They must have medical care: a doctor, a dentist and a couple of assistants. Adding these four, we get 126.

Then we need a laundry, barber, shoemaker, tailor, water detail, police detail, and so forth; say 14 more, making 140 in all.

Now, we have to look out for the spiritual, mental and social welfare of our troops, so we can't let them just sit there and think up mischief. We need a chaplain, an educator, an athletic director, an entertainment director, and a post exchange. That brings us to 145.

This is now a "company" in size and that calls for five officers to supervise, making an even 150.

But when we took on our kitchen force, we figured on only 100 men, and now we have 150. We must increase the cooks—and the guard. You see how it works?

Don't jump to conclusions yet, though: that's only the beginning.

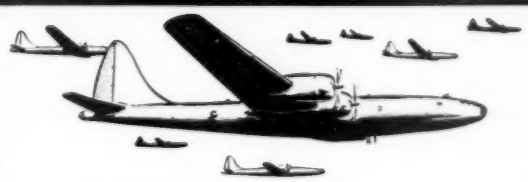
All this is for 100 men that are *doing nothing.* Now let's make each of these 100 men a pilot commanding a medium bomber and see how our little project grows.

First, each bomber commander must have a navigator, bombardier, co-pilot, flight engineer, radio operator, gunners, etc., totalling 10 or 11 besides himself. Next there is the ground crew, about an equal number, which maintains and services the ship while the combat crew is resting. Then, the heavy shops, weather station, control tower, radio station, and all the other agencies needed to keep airplanes flying.

Already each of our 100 men has spawned about 40 more, and we still have a long way to go. We can't send bombers into a combat situation without fighter escort and base protection. It will take at least as many fighters as bombers, and they must have (*Continued on page* 55)

Building airstrips ahead of air armadas is an essential task.

MANPOWER NEEDS FOR 100-BOMBER FORCE



1,000	Aircrewmen.
1,000	Maintenance personnel.
2,000	Heavy shops, weather, control tower, radio station, etc.
2,000	Fighter pilots, maintenance personnel, etc.
2,000	Runway maintenance, storage, bomb fusing, loading bombs and rockets, base repairing, etc.
8,000	Ground support, antiaircraft, etc.
8,000	Feeding, clothing, guarding, doctoring, other housekeeping, etc.
24,000	Total.
?	Additional men for construction of docks, warehouses, airbases, barracks.

Boeing's 70-ton Stratocruiser is world's fastest and largest commercial landplane.

Double-Deck Airliner

Spiral stairs connect upper deck of the Stratocruiser with a combination dining, observation and cocktail lounge on lower level. The lounge will seat 14 persons.

By FREDERICK B. COLLINS

Vice-President and Sales Manager
Boeing Airplane Company

THE QUEEN ELIZABETH of the airways, Boeing's 70-ton *Stratocruiser* is the world's fastest, largest and most luxurious commercial landplane. Soon after the first of the year, the $1,500,000 airliner with the figure-eight fuselage will go into transoceanic service with Pan-American Airways, and shortly will join Scandinavian Airlines, Northwest Airlines, American Overseas Airlines, United Air Lines and the British Overseas Airways Corporation.

Adapted from the Boeing B-29, the giant transport cruises at from 300 to 350 m.p.h., has two decks connected by circular stairs, a 14-seat lounge and snack bar, berth accommodations for as many as 45 passengers on the upper deck or 60 in deluxe day chairs, and is powered by four 3,500-h.p. Pratt & Whitney engines.

The *Stratocruiser* will, apparently, be a money-maker. With as few as 10 passengers (at 5.5 cents per mile) and one ton of cargo (at 51 cents per mile), the plane's operators can break even on direct flying costs. That's only 16.4 per cent of the big plane's capacity. Revenue from the remaining 83.6 per cent of available space can be credited to indirect costs and profit.

That's possible because 43 per cent of the *Stratocruiser's* gross weight of 142,400 pounds is available for useful load, a significantly high ratio. The liner's faster speeds also enable fixed costs to be distributed over more revenue miles.

Maintenance on the plane is streamlined. Typical of simple procedures is engine repair. Cowl sections can be removed quicker and more easily, and the whole (*Continued on page* 64)

Flying "front office" of plane has spacious stations for five crew members: pilot, co-pilot, engineer, navigator, radio operator.

Upper deck has accommodations for 60 daytime passengers. Front part of cabin, including stateroom, also contains berths.

Giant airliner has a cruising speed of 340 m.p.h., range of 4,200 miles. Wingspan is 141 ft. 3 in., height 38 ft. 3 in., length 110 ft. 4 in. Plane, adapted from B-29, costs $1,500,000.

Cocktail lounge on lower deck has luxurious fittings. Two cargo holds, also on lower level, have total capacity of 830 cubic feet.

Berths are created from four standard daytime chairs. Sleeping accommodations for 45 passengers are contained on upper deck.

Taylorcraft 85

Cabin interior and instrument layout are neat. The plane has doors on both sides. Five standard flight and engine instruments are located in center of dash.

FLYING CHECK PILOT

EDITOR'S NOTE

This series of articles is planned to help the pilot and prospective plane owner evaluate aircraft now on the market. Only aircraft holding a CAA Approved Type Certificate are flown. The author is not a professional test pilot. He evaluates each aircraft through the eyes of an average private pilot who flies an airplane either for business or sport.

By MAX KARANT

Assistant general manager and editorial director, Aircraft Owners and Pilots Association

TAYLORCRAFT has had more than its share of headaches in the past and now is in the process of moving from its old home town of Alliance, Ohio, to a new plant at Conway, Pa., near Pittsburgh. Main reason for the move is that the company has been unable to find all the facilities it needs under one Alliance roof. It has been producing airplanes in three shops in three different sections of town.

Despite the move, however, Taylorcraft is producing airplanes and is continuing normal deliveries. The company has a line of three models, all two-place, fabric-covered and basically the same design: the low-priced *Traveler* ($1,995), the 1949 Model 65 ($2,365) and the 1949 Model 85 ($2,585) which will be discussed in this article.

To say that this is a new design is just to give the boys in the sales department something to talk about. Its CAA type certificate was issued in August, 1938. The main difference between the 1949 model and its predecessors is the bigger engine—an increase of 20 h.p. which definitely improves the airplane's performance, particularly on take-off. Otherwise, a pilot experienced with Taylorcrafts could climb into this plane and carry on blindfolded without missing a lick.

This is no reflection on Taylorcraft. It's in the same class with so many other private planes and compares favorably with nearly all its contemporaries in the same horsepower class.

As a matter of fact, nearly all the engineering and development comes from the hands and head of C. G. Taylor, just as it did in the (*Continued on page* 70)

Taylorcraft 85 sells for $2,585, cruises at 100 m.p.h. with 350-mile range. In CAA tests, fully-loaded plane took off in 264 feet.

Ice and snow can cause pilot headaches but need not damage winterized aircraft.

TIPS ON WINTER FLYING

Rubber is brittle, metal snaps, oil congeals in zero weather.

WHEN the temperature dips below freezing, the weather-wise pilot gets out his old flying rule book and revises his standard operating procedures. He knows that engines and airplanes can get cantankerous if not handled properly in very cold weather. He knows that snow, ice, freezing rain and cold can make an otherwise docile plane do unusual things.

But if he's a veteran pilot, he also knows that adequate care will keep the airplane operating efficiently and safely even in bitter weather.

Sometimes it is necessary to make alterations, service changes or additional installations in order to assure safe winter flight. Each model of aircraft needs different treatment—and no set of instructions can blanket the requirements for every plane. The winter pilot needs to know his plane, and then analyze the degree of cold and type of operation he wants before he can attempt satisfactory winterization of his craft. It is not a simple job.

Even so, some very basic points need to be considered by every pilot who considers flying in sub-zero weather. Familiarity with these general rules and requirements can make winter flying a pleasure. Ignorance of them can be disastrous.

COLD WEATHER SAFETY

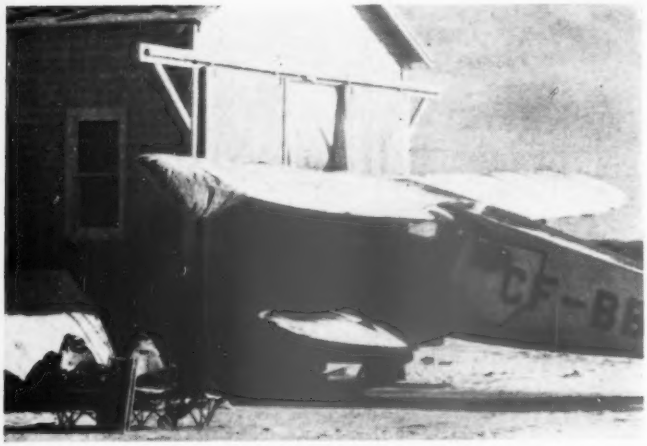
This article is condensed from the new CAB pamphlet, "Cold Weather Safety" (Safety Bulletin No. 181-48), by Fred G. Powell, Accident Investigation Division, Safety Bureau, Civil Aeronautics Board. Copies of the complete pamphlet can be obtained from the Superintendent of Documents, Washington, D. C., for 10 cents.

OIL SYSTEMS AND OIL are cases in point. If your oil lines, oil tank and so forth are covered, you will have an easier job maintaining oil above the minimum operating temperature. In the coldest weather it's good to have a gauge indicating temperature of out-going engine oil, since most planes have gauges that record only in-coming temperature.

Beware of poor oil. Light viscosity oil sometimes is "watery" at operating temperatures. *Viscosity index* gives an indication of quality. When oil is drained for later preheating, use covered cans if possible. And if you have more than one plane, use a separate can for each. Then if you find any metal in a can you know which plane it came from.

Standard oil and grease on retracting gear mechanisms may seize. That's why it's a good idea to use dry, finely-powdered graphite whenever possible. Remove grease from the worm gears and apply light oil, such as penetrat-

Cold weather pilots try to keep their gas tanks full because partly filled tanks sweat inside and ice particles may stop the flow of fuel.



Nose hangar of Canadian Pacific Air Services is ideal arrangement for pre-heating engines. Nose tents heated by blow torches are also used.

Skis are valuable but there is no ideal standard ski. Experienced pilots rig their skis to provide an appreciable amount of incidence.

ing oil, frequently. Congealed grease and oil in controls may make them immovable. Clean and use a lighter lubricant.

Additional cowling is sometimes needed but cowling changes should be properly engineered. Even small changes can cause bad heat distribution. Operators have had best results in controlling temperatures by partially restricting the exhausting air openings.

PREHEATING ENGINES. The familiar plumber's blowtorch is still successful, especially where modern heating units are not available. The engine should be clean and free from oil and fuel leaks. If the drop-skirt type of engine cover is used, best practice is to place the blowtorch slightly forward and at least three feet from the bottom of the engine. Frequently only an engine cover is used, with the heater well forward of the engine and the heat being conducted to the engine by a slanting stovepipe. This method appears to be a lesser fire hazard, but a baffle is needed on top of the heat-conducting pipe to prevent heat concentration on the engine. It is difficult for operators of small craft to carry the added equipment.

Beware the use of more than one blowtorch. Sometimes one torch goes out, atomizing raw gasoline within the tent. The explosive vapor thus formed is fired by the lighted blowtorch. Maintain a constant watch at all times, but especially when more than one heater is used. If guard personnel seek warmth within the engine-heating tent they should remember that carbon monoxide gas is always present.

Some blowtorches emit sparks—and no fire-resistant treating of heating-tent skirts is absolutely reliable, especially when old or oil-soaked. Operation of a heater in a barrel or drum lessens the fire hazard, especially in a wind. Loss of heat during fire-potting can be prevented by placing folded wing covers or blankets on top of the tended engine.

Running out the carburetor—allowing the engine to stop from fuel exhaustion after shutting off the fuel—does not entirely exhaust fuel from the carburetor but it does minimize the fire hazard. A filled carburetor may overflow when heated and fuel in the carburetor vaporizes during fire-potting.

ENGINE PRIMING AND STARTING. The output of a storage battery may be less than 50 per cent if its temperature is sub-zero. It may be restored to efficiency by slow heating or by placing it on a charging circuit. Do not heat rapidly by external means.

Carburetor heater should be off or cold when starting, otherwise it may be damaged by a backfire. Also check the spring-loaded blow-by valve in the air scoop to see that it is not frozen shut.

Check manufacturer's specification against your own experiments as to the correct r.p.m. for beginning warm-up. At too low r.p.m. the engine may "load up" or carburetor may not perform properly, causing engine to "pop back." Too high an r.p.m. warms the engine too quickly and may rupture an oil-scavenging line or connection.

When an engine does not begin firing normally after the first few attempts following preheating, indicates lessening signs, and finally does not fire at all, check for ice across the spark plug electrodes, as this phenomenon can occur very quickly. When an engine does not start immediately it is frequently overprimed. Extra precaution should be taken against external fire. Be careful of overpriming. In some types of installation, pumping throttle when engine has been returned to "full rich" position may cause considerable gasoline to drain to the air intake chute and leak from (*Continued on page* 64)

Rose Bowl, scene of football's annual classic, is near good airports but tickets for game are hard to obtain.

A FLYING Holiday

Rose Bowl Game

By DON DOWNIE

Aviation Editor, Pasadena (Calif.) Star-News

IF OVER a million people gather each New Years morning in California, there must be something to see. If 96,500 jam the Rose Bowl for the annual east-west football game, and tickets sell at three times their purchase price, the sporting public must be more than eager to see the game.

It happens every New Years Day in Pasadena.

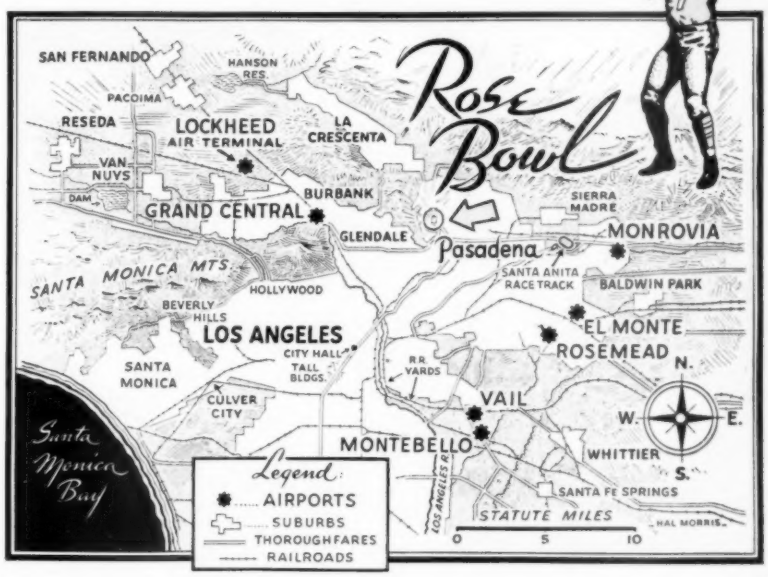
The largest crowd in the whole country gathers annually to watch 57 flower-decked floats, 20 marching bands and 200-odd equestrian entrants form a five-mile-long parade. The crowd last year was variously estimated between 1¼ and 1½ million spectators.

New Years in Southern California normally makes an ideal flying holiday. Only once in the 60-year history of the Rose Bowl game has the event been hampered by heavy rains.

In addition to the Rose parade and football game, the opening of nearby Santa Anita Park is set for December 28. Last year over 63,000 fans attended the New Years Day horse races.

Seats for the Rose Bowl game, January 1, are at a great premium and local ticket agencies strongly advise against coming to Pasadena and then hoping to buy a ticket. Harold Lurie, manager of the Gittelson's Bros. ticket agency, typical of the large Los Angeles booking houses, advises that last year he had very few tickets and these sold from $10 to $15 per seat. He says that "at this time we cannot provide tickets or quote prices. It is doubtful if any will be available." Pilots from the east should try to arrange for tickets through Northwestern University of the "Big Nine."

Of the 93,000 paid ad- (*Continued on page 66*)



Flight engineers must be included in crews of three airliners now in use: the Constellation (above), Stratocruiser and DC-6. Only the DC-6 has no provision for a flight engineer station in the cockpit design.

Third Man in the Cockpit

New CAB ruling requires flight engineer on biggest transports.

By RICHARD SAUNDERS

FLYING's Washington Correspondent

WHEN the Stinson Model A transport went onto the airlines in the early days of air transportation, the old Bureau of Air Commerce ruled that two men would be required in its cockpit. The Stinson was too complicated for a one-man crew. It not only was a tri-motor but it was the first airliner in general use which had retractable gear.

Airlines accepted the regulation quietly. The co-pilot was added, and since has become an accepted institution.

Such was not the case when the CAB recently ordered *a third man* in the cockpits of today's largest transport planes. The Board's order requires a flight engineer in the crews of giant airliners.

Most airlines opposed the ruling vigorously.

Specifically, the order directs airlines to place flight engineers on four-engined planes having a maximum take-off weight in excess of 80,000 pounds.

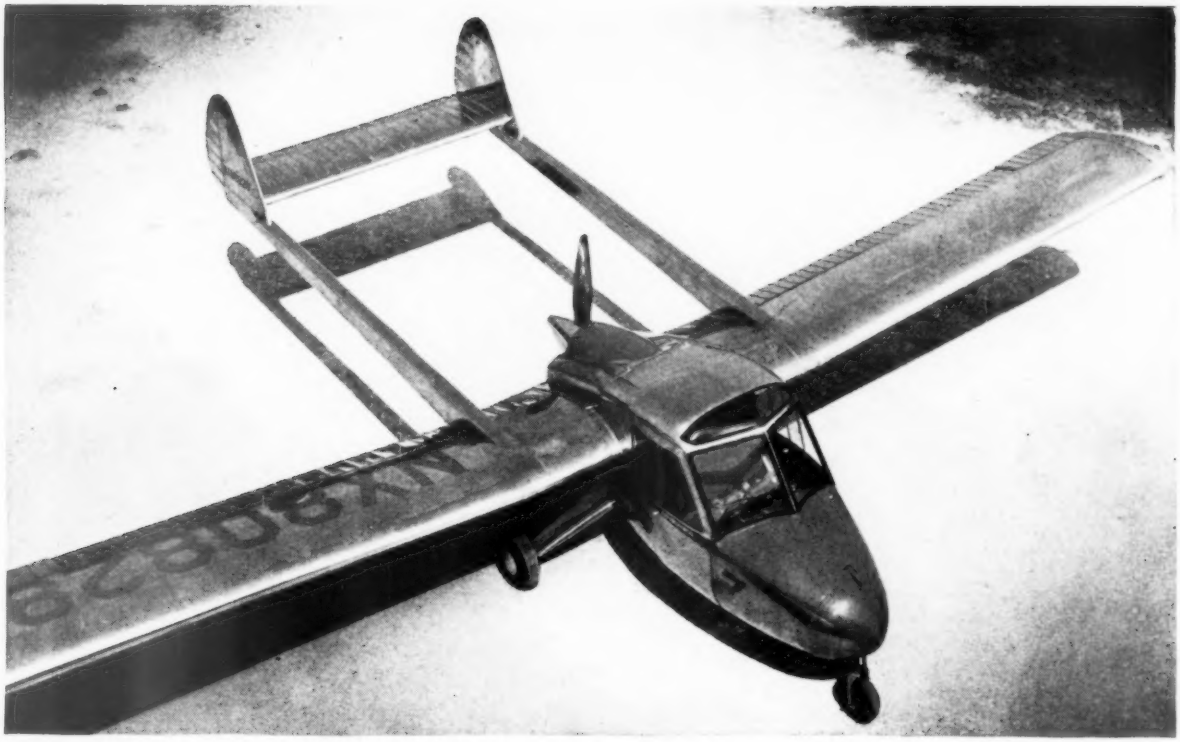
What was all the shouting about? Why did most of the airlines object? Why did the Airline Pilots Association nod its head in vigorous approval? The answer to these questions is to be found not so much in the philosophy behind the order as in the way it is being applied.

It is fairly easy to see what made the shoe pinch in the beginning. Of the three types of planes affected by the order, only one—the DC-6—is not fitted out with a station for a flight engineer. The other two are the Lockheed *Constellation* and the Boeing *Stratocruiser* (Model 377). In both cases provision for a flight engineer is made in the cockpit design. It was not hard to demonstrate that a flight engineer on these planes where he would have his own special seat and panels would make a real contribution.

Going to bat with the issue in the case of the DC-6, the airlines, led by American, took the position that there was not enough for a flight engineer to do to justify his presence in the cockpit; that merely sitting on the jump seat he would be so much excess baggage. An outstanding exception in this drive to have the order rescinded or modified was United Air Lines. United contended that a third crew member would be an added safety factor.

Thus the first round is over. In refusing to back down or grant an over-all stay, the CAB reaffirmed its view that there is enough to do in flying the larger aircraft to more than saturate the abilities of two men.

To dramatize the vital role that a flight engineer could play, CAB officials point to specific crashes that probably could have been avoided if an additional pair of hands had been available in an emergency. Of course they cannot be sure in such conjectures. But they cite several crashes resulting from fires that had their origins in overflows when gas was being transferred from wing tanks. They believe that a flight en- (*Continued on page* 71)



Anderson Greenwood 14 is all-metal two-place pusher plane reminiscent of Airsedan proposed by FLYING in August, 1945. Craft is built in Houston, first flew late in 1947. It is powered with a 90-h.p. Continental engine, cruises over 110 m.p.h., has four-hour range; wing span is 34 feet.

HAVE YOU SEEN?

Rose Parakeet has been rebuilt for aerobatics and stressed for 10-G load. Bill Fischer flies the 18-foot span plane with Flying Tiger's Air Show.

Avicar BF-8 is two-place plane-car built by Kenneth Bailey of Dearborn, Mich. Engine is 65 h.p. The wings have only 8-foot span and do not fold.

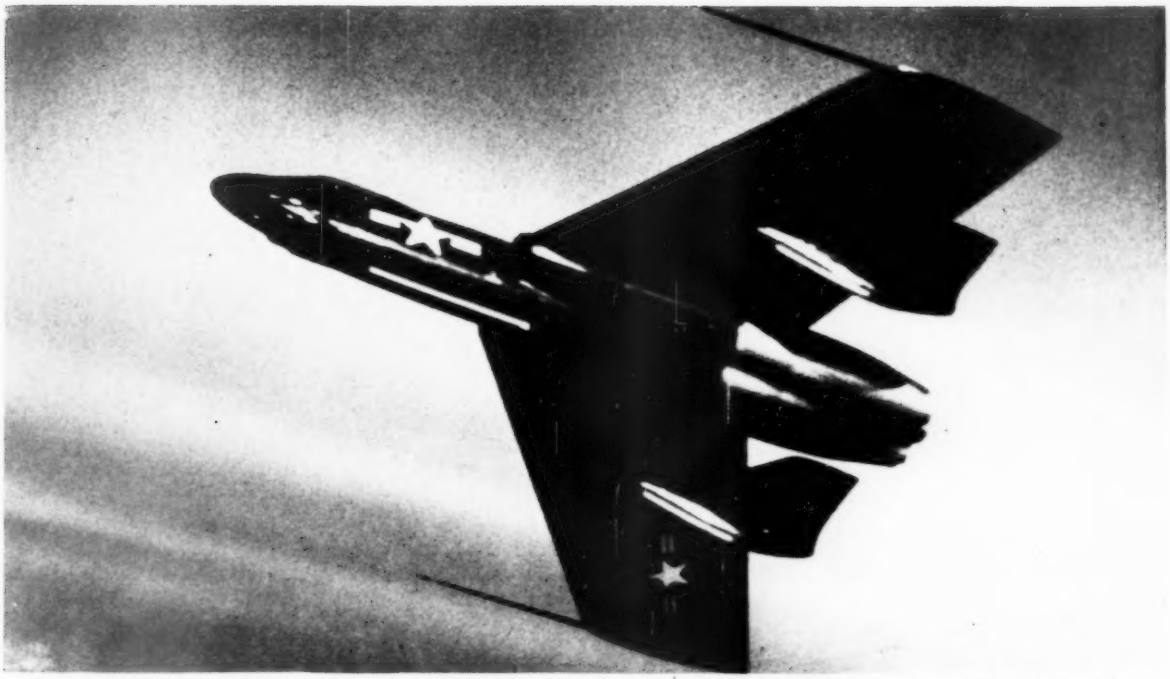
Low-wing monoplane built by Jack Hash, Crosbyton, Tex., cruises over 100 m.p.h., climbs 800 f.p.m.

New helicopter has been developed in Baltimore by Hamilton Helicopter Company, Baltimore Municipal Airport. Craft has all-metal fuselage, is powered by 125-h.p. air-cooled engine. Plane has undergone tethered lift checks and is expected to fly soon. Speed may be 100 m.p.h.

Cierva Skeeter is new two-place light British helicopter designed to sell at less than $8,000. It has 100-h.p. engine.

Hiller 360 has recently been licensed by CAA. Craft has overhead stick control which is claimed to make it basically stable.

Converted Boeing Fortress is used as flying laboratory to test new Wright Typhoon T-35 aircraft turbine. The huge engine is mounted in former nose section of plane. Results of tests have not been released by the Air Force, but power may be in the 5,000-10,000-h.p. range.



New Navy swept-wing fighter is Chance-Vought XF7U-1. Two Westinghouse turbo-jets give it speed in the "over 600-m.p.h. class." Vertical stabilizers and rudders are located at trailing edge of the wing. Plane has leading edge slats which give it a low-landing speed.

World's smallest airplane is the Weebee, designed by Aeronautical Engineer Ken S. Coward. Weebee has 15-foot span and weighs 170 pounds. Three instruments are in front of pilot. Control stick is reached by armholes in fuselage. Rudder pedals are operated by feet.

First swept-wing jet bomber was Junkers 287, designed to fly at speeds approaching Mach 1.0. Russians seized the craft.

Canadian jet transport is Avro C.102, expected to fly next spring. It is designed to cruise 400 m.p.h. at 30,000 feet.

I Learned About Flying From That! NO. 110

By CHARLES N. MONCURE

Snow was blinding, pilots were lost, radio was out. The rest was just luck.

THE new Cessna 140 climbed beautifully out of Boeing Field, Seattle, Wash., that December afternoon. Weather wasn't so good—ceiling 2,500 feet, temperature 37°, dew point 25°, with occasional light snow. But the Cessna had all the blind flying instruments except a turn-and-bank indicator. We had just installed a new GE radio and wanted to test it.

Norman Landis, a student pilot with about 20 hours, was at the controls logging some dual cross-country time. Our destination was Chehalis—about 70 miles airline.

The radio beam passes east of Chehalis, so we headed a little toward the west, hitting some rather heavy snow.

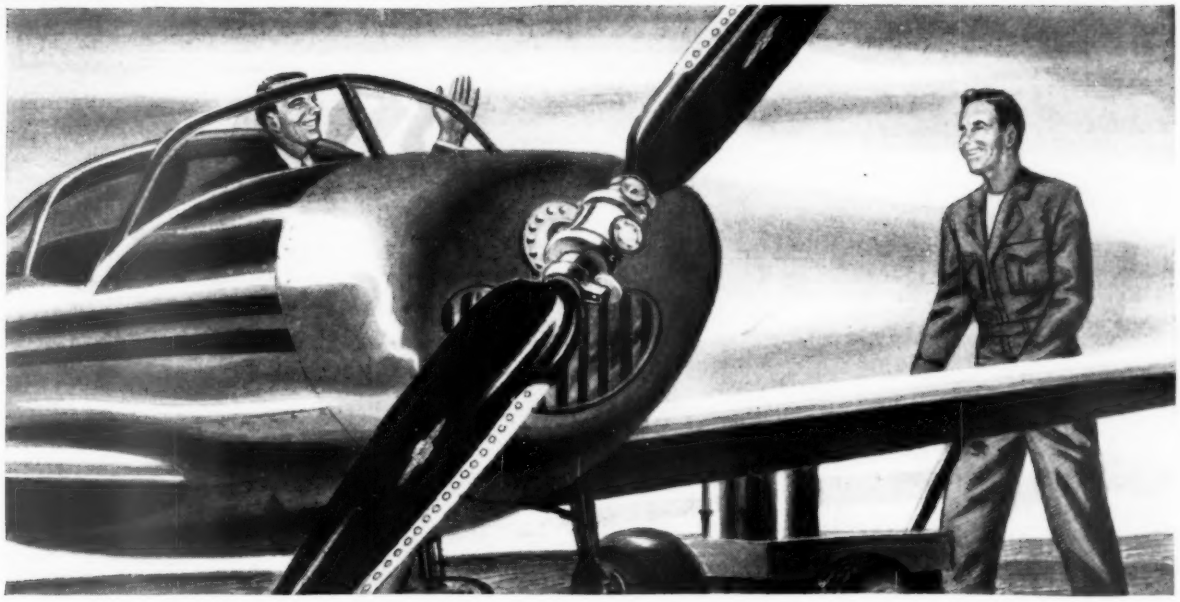
Under normal conditions we would have had no trouble—but the snow flurries limited visibility. Perhaps we struck off too sharply toward the west, because about the time we should have arrived, we weren't able to see the town.

Neither of us were bothered, though. There was an easier and safer solution than cruising around, looking for a town when we weren't familiar with landmarks. "No problem at all," I mused to myself. "We can ease over to the east, get back on the beam, and follow it into Toledo for a landing." Both Norm and I had a false sense of security, based entirely on that little radio. I had 440 hours and a commercial license, and felt completely confident.

Looking down through the snow, I caught frequent glimpses of logged-off land. And then the hills started to rise abruptly. About that time, we got on the beam—and smack into a thick snowstorm. Still, neither of us were apprehensive. I called Toledo radio to check the weather and report our approximate position. The operator reported ceiling 7,000 feet, visibility 12 miles, temperature 34°, dew point 30°.

I glanced over at Norm. He was obviously not enjoying his dual cross-country. He peered around—probably wondering what had happened to the 12-mile visibility reported by Toledo. Snow was swirling around us and we were at 2,500 feet indicated altitude. The ground appeared to be getting closer, so I took over the controls and started to reach for higher altitude. I reversed our course—but not soon enough. Visibility instantly lowered to zero, and I was afraid to let down. The last glimpse I had of the hills below had been minutes before and at that time they looked awfully cold. We roared along, the engine running smoothly. Suddenly I noticed ice drops beginning to form on the windshield. I wondered if our wings were icing up.

I called Toledo radio again, (*Continued on page* 63)



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AOPA NEWS

Aircraft Owners and Pilots Association is a service organization for the private pilot or aircraft owner. AOPA's full time staff is devoted to helping the individual pilot. Its aim is: "To make flying more useful, less expensive, safer and more fun."

Headquarters are: 15th and New York Aves., Washington 5, D. C. Members also receive a special AOPA edition of FLYING, newsletters and confidential aviation data. Opinions expressed in this column are not necessarily those of FLYING MAGAZINE.

MENU FLIGHT

Novel variation of the famed progressive-supper hike was staged recently by the Pottstown, Pa., AOPA Unit. The group staged a progressive-supper flight, with 17 planes and 49 pilots and friends participating.

First course (tomato juice) was served at the Unit's home airport. The soup course was at New Hanover airport. Main course—steak, with all the trimmings—was served at Central airport. Camden, N. J. Pumpkin pie and coffee were served at Valley Forge airport, near Norristown, Pa.

YOUNGEST?

Bill Baxter, of Atlantic, Ia., is at least the youngest pilot in his home state. He soloed when he was 16, after working at a local airport to pay for his lessons. He's now an AOPA member (47661), is 17 and has 70 hours, 48 of them solo.

ANOTHER SAVING

Safe Flight Indicator stall-warning indicators are once again available to AOPA members at a substantial saving. By special arrangement with the manufacturer, AOPA has effected a $9.50 saving on each instrument, making the member's price $37.50 for an SFI. Procedure for obtaining the SFI at this saving are in THE PILOT.

DETROIT CLINIC

AOPA introduced 10 "bills of policy" at the Sixth National Aviation Clinic at Detroit. The bills were designed to promote development and improvement of personal planes and facilities. Two bills were voted down by delegates representing aircraft manufacturers and airport operators who have sales agencies.

One of the rejected bills recommended establishment of minimum standard dimensions of the human body, to be used in the future when designing personal planes. The other rejected bill advocated immediate establishment of a central research and development program for personal planes and equipment.

LANDING FEES

AOPA is continuing its campaign to eliminate landing fees for private flyers. Cities recently revealed as having objectionable charges include Pittsburgh, Cleveland lake front, Chicago lake front, Ballston Spa, N. Y. Recent reports of such fees at heavily-used Teterboro, N. J., airport have been untrue, although the field is now controlled by the Port of New York Authority, which may ultimately mean that landing fees will be charged, as they now are at LaGuardia, Newark and Idlewild.

CROSSWIND STRIPS

A Washington expert has just come up with the estimate that our present airport program could be cut $250,000,000 if all present-day aircraft were equipped with crosswind landing gear. AOPA has contended that any Federal funds for new airports should be held down to the requirements for adequate single-strip runways, closer to the centers of population. Economy-minded appropriations officials in Washington are listening attentively to such proposals.

SPINS OUT

Hearings are expected to be held shortly in Washington by the CAB to determine whether the spin requirement in pilot's flight-test examination should be retained. The draft release issued to the industry for comment drew wide and varied replies. No actual change will be made in the regulations, however, until hearings are held.

DUST YOUR OWN

CAA advises AOPA that it is recommending to CAB that the regulations be changed to permit private pilots to do crop dusting or aerial planting on their own farms.

CAA PLANE RENTALS

Now that CAA is renting personal aircraft for the use of its personnel, it is paying them a flat rate of 10 cents per mile to cover such rental. Indications are that it's actually costing between 14 cents and 17 cents per mile, however, with CAA personnel paying the difference from their own pockets.

INDUSTRY MEETINGS

Shortcomings of the personal-plane manufacturers and fixed-base operators were discussed in detail at the recent annual meetings of the Indiana and New York state aviation trade associations. These discussions were led by an AOPA official.

FILMS AVAILABLE

CAA now has more than 600 motion picture films on aviation available for loan. AOPA members interested can get a bibliography of these films after January 1 by contacting AOPA headquarters, CAA's Washington offices or one of its regional offices. One of CAA's most popular films is the color picture "Our Town Builds An Airport."

EFFICIENCY RACE

One of the largest Efficiency Races yet held was staged recently at Wings Field, Ambler, Pa., with 72 planes entered in 10 classes. These types of planes were raced: Beech *Bonanza*, Cessna 140-120, Cessna 170, Bellanca *Cruisair*, *Ercoupe*, Luscombe, *Navion*, Piper *Family Cruiser*, Stinson *Voyager*, and Temco *Swift*.

Most surprising performance turned in: the winning *Bonanza* flew the 218-mile course at an average speed of 114.7 m.p.h., burning an average of 3.8 gallons of fuel per hour. Only airplanes that turned in a better fuel-consumption record were a Luscombe and *Ercoupe*.

Bonanza's performance, however, has been responsible for a forthcoming change in the performance formula on which these Efficiency Races are based. New formula being worked out will remove much emphasis from fuel economy, place more emphasis on skillful piloting and navigation. AOPA's Pilot Service Bulletin No. 12, which outlines the method for staging Efficiency Races, will be changed accordingly.

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YOU CAN DEPEND ON

LOGGING TIME

WITH HY SHERIDAN

Captain, American Airlines

THE RACING RAIN. You remember my story in FLYING, called The Mystery of the Racing Rain, and I warned you fellows not to be goofy enough to get caught when the weather swoops? I ought to read my own stuff, I guess. It happened to me.

A few days ago I took off from Detroit for New York with the bad weather a good 400 miles down the coast and me with a nice VFR flight plan and gas tailored therefor. I had my coffee and a cigar and a word with the stewardess, and there I was over New York getting holding instructions.

When I asked why they said, "Oh, didn't we tell you? New York ran out of ceiling an hour ago." I throttled the engines down until they were running strictly on memory, and it is a good thing that I did.

I asked for a clearance to an alternate and that seemed to surprise them. After 30 minutes I asked again. "We are working on it," they said. After a few minutes more I took the bull (this is not a figure of speech) by the horns and went to Boston, where I landed minus 300 gallons of gas, according to the clock.

A couple of co-pilots were talking about the case the next day. "I'll bet he was low on gas," exclaimed Fred Schwartz.

"Haven't you read his column?" said First Officer Stentz. "That guy will never be low on gas."

* * *

Sadie the Stewardess says that the new fad the girls have of wearing wired bras is not only pretty but it is practical, too. She is shopping around for a barbed wire one.

* * *

CO-PILOTS. In 1946 the airlines had expansion plans. The co-pilots could see themselves as captains shortly, full of importance and sirloins. But when the war was over the passengers just didn't increase as everyone had planned. And the new, fast airliners were a problem, handling the business so rapidly that one plane will do what two used to do.

About the only hope the co-pilot now has for promotion is for the captains to just wear out. Someone said that the co-pilot doesn't feel good unless the captain feels bad.

In Timaeus, Plato asked, ". . . and what is that which is always becoming and never is?" We had to wait 2,000 years to find out. It is the co-pilot.

* * *

WATCH THE HELL OUT

When any of you fellows see an airliner flying in your vic . . . vic . . . near you, why, change your flight plan to WTHO. That means Watch the Hell Out. The reason is that the modern airliner has been improved until you can hardly see out of it. If there is anything in what Mr. Darwin said, someday the airline pilot will have eyes on stalks like some of the other insects. They say that the firefly lights up its rear end as a s-xual lure. Don't you believe it.

If a person looks in all directions in the three dimensions, he would sweep what has been called the visual sphere. How much do you believe that the airliner pilot can see through his windshields and cockpit windows?

It is less than five per cent of the visual sphere in such planes as the DC-6. In other words, he is 95 per cent blind under the best conditions. And he is even blinder when he looks at his many instruments. He shouldn't, but he does look at his instruments. He finds in them an entertainment value.

* * *

Sadie says that when a girl gets boiled she is likely to find herself undone.

* * *

A COSMIC THOUGHT

Once upon a time, and it may have been yesterday for all we know, a male chromosome had a presentiment that a female chromosome was nearby and in a more or less thoughtful mood. We need not look askance at the male chromosome, for this characteristic, of necessity, ran in his family.

"Suppose," he supposed, "that you and I get together."

"All right," the female chromosome agreed and then she continued as is the way with her kind, "but I must say that you have a strangely elaborate way about you."

Nevertheless she did not say this, children, until she was sure of where she stood.

* * *

MONTHLY EPITAPH

Here lies the pilot who stretched his glide,
But he stretched his luck—the guy's inside.

Daring Young Genius

(*Continued from page 29*)

turn down his revolutionary combination of the gas turbine and jet propulsion. Gas turbines were not a new idea. As early as 1791, John Barker had patented the first gas turbine in England but all efforts to produce one had failed. When Whittle came along in 1929 they said, "Another gas turbine, eh? No chance."

"They were probably right," says Whittle, "for we still had to wait for the development of new alloys that would keep their strength at the necessary high temperatures. That was the key thing. Also it was a vicious circle, for such alloys were not needed until the gas turbine was developed and the gas turbine was not possible without the alloys. The first break came with the special steels produced for steam turbines at high temperatures and for aero exhaust valves."

But it wasn't until 1935 that two ex-RAF officers, R. D. Williams and J. C. B. Tinling, were successful in helping Whittle get the money to start. "We raised £2000," says Whittle, "and with this we went cheerfully ahead."

The Germans were cheerfully going ahead, too, for four years later, in 1939, the German magazine *Flugsport* published seven detailed drawings of Whittle patents. Probably out of these were born the deadly German jet fighters that flew circles around our swiftest propeller planes and shot down our bombers during the last weeks of the war.

That same year the Air Ministry—in Whittle's restrained prose—"ceased to regard the development of jet propulsion as a matter of long-term research." By this time there had been three solid years of heartbreaking experimentation, the making of many models, and many failures. "We often did more running than our engine. There were some narrow escapes. Once we were running an engine in a room smaller than this," said Whittle (indicating my room in Claridges Hotel in which we were lunching), "and the engine blew up. Four people were in the test cell but though the floor was littered with wreckage only two men were slightly injured and in the same way—a small fragment of metal pierced the nose of each. The rotor burst. It was a miracle that no one was killed outright."

At the beginning of 1940 the Air Ministry decided there was a good chance of getting jet fighters into the war and authorized the design for a twin-engined interceptor fighter. Built by Gloster in 1941, this was the prototype of the *Meteor* which first saw successful action against the buzz bombs—the V 1s. "Did you ever hear how the first *Meteor* knocked down its buzz bomb?" Whittle asked. "It flew along in formation with the 'doodle-bug' and tipped it over with its wing tip."

Whittle could appreciate such daredevil flying. For years he was one of England's most famous acrobatic stunters. There were annual contests in "crazy flying" and the winning team per-

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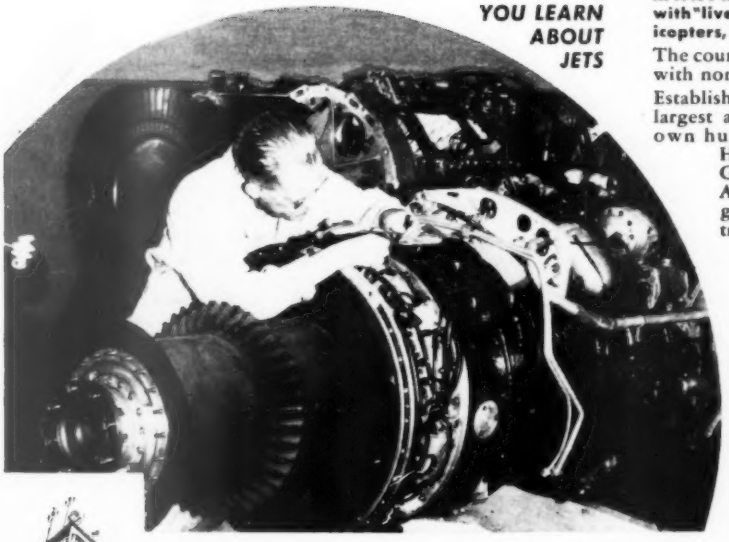

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formed at Hendon in the RAF display while thousands cheered. Whittle was the prize "student" in the championship "instructor-student" team. The "instructor" would execute intricate loops perfectly. The "student" would follow with great dash, only to fall out of the tops of the loops, scrape the ground with the tips of his wings and cheat death over and over by a cat's whisker. After this the "crazy flyer"—young Whittle—would go back to his drawing board and work on his "crazy" jet propulsion.

Not all of Whittle's "crazy flying" was stunt work. As one of the RAF's test pilots, part of his job was to try out every new type of catapult—the gadget that shoots planes off the decks of warships. Strapped in his plane he would be catapulted off the old *Ark Royal*, like the human cannon-ball at the circus. "I survived," says Whittle modestly, "but once my passenger forgot to strap himself in—an unfortunate oversight; he had a ride on the tail plane."

Whittle was born 41 years ago in Coventry, the capital of English automotive and precision tool industries. Whittle's father and grandfather were engineers, and an early picture of Sir Frank shows him, aged four, holding a model airplane. He was an awed young aviation cadet when Lindbergh flew the Atlantic and on his first lecture tour in the United States Whittle made a beeline for the Smithsonian Institution in Washington to see Lindbergh's historic "Spirit of St. Louis."

"Would you have cared to fly across the Atlantic in it?" I asked. "No indeed!" he said, "nor even in the single engined jets that have just crossed the Atlantic both ways. I want plenty of engines over water."

Although he has spent most of his adult life over the drawing board, Whittle has more than 1,000 flying hours to his credit. "I've flown practically every class of airplane," he says. "My latest was a civil airliner powered by four propeller gas turbines." Was he worried? No, nor apparently was the company who made it, for on this flight he had with him the chief engineer, the chief test pilot, chief of the experimental department and other high officials of the company. Compared with this latest giant, the first Whittle engine had only 850 pounds of propulsive thrust. Whittle says there is no trouble about increasing the size from the present 5,000 pounds to 8,000 or 10,000, but he prefers to increase the number of engines after 5,000.

Top airline executives from all over the world who invited Whittle to make the principal address at their meeting in Brussels in September were told that jet-driven airliners cruising at more than 500 m.p.h. are nearly here but they must wait for better airport handling. "You cannot stack up jet liners and make them circle the field interminably awaiting their turn to land, for jet planes drink too much fuel cruising at low speeds and altitudes. But at speeds of 500 m.p.h. and more and above 30,000 feet they have three times more range than at sea level and are far more efficient than any other type of plane."

Whittle, who is technical adviser to BOAC on aircraft gas turbines, advised the airline companies of the world to change over to propeller gas turbines within the next five years and to prepare to switch to jets when other developments had solved the stacking problem.

Later he told the top brass of the world airlines that everything was moving almost too fast in the jet field for anyone to keep up, including himself. "I had to revise this talk many times in the previous two weeks. For example, since I started writing my notes, three British engines have run off 500 hours each, equal to 250,000 miles apiece, or 10 times around the globe—one of them with only 13 man-hours of maintenance. As for speed, it seems as though every day sees a new record chalked up."

Four days later a world speed record of 670.981 miles an hour was claimed by the U. S. Air Force for a standard, fully-armed F-86 fighter. In the same week the British announced that a DeHavilland 108 Research jet had exceeded the speed of sound in a steep dive at an altitude of between 30,000 and 40,000 feet, where the speed of sound, which varies according to the height above sea level, is reckoned around 675 m.p.h. The next day it was revealed that all first-line squadrons of the RAF Fighter Command already have been switched from *Spitfires* and other war types to jet planes and the RAF was getting down to changing over bombers to jets as well.

I asked Whittle, the RAF's top technical adviser on this jet problem, if the Russians have anything in jet planes today that we don't have. He replied thoughtfully, "We know they took over German planes and technicians at the end of the war. We also know that despite the widespread belief that the Germans were far ahead of us, this was not true. Their best plane was good for only 25 hours in the air while our best was good for 150. The engines with which they finished the war were no better than our first flight engines. But what the Russians have done since, or what they have now is guesswork. I believe that we in England are ahead in the jet propulsion race—and we hope to stay there—although you in the United States are breathing hot on our necks."

If true, we have Sir Frank Whittle himself to thank, for one of the well-kept top secrets of World War II was how jet propulsion first came to the United States. On October 2, 1941, a U. S. *Liberator* landed in Washington from England on a hush-hush flight with a Whittle jet engine, a set of working drawings and a team of technicians. Whittle himself followed secretly in 1942 and lived under an assumed name in Boston's Statler Hotel from which he commuted to advise the General Electric Company in Lynn, Mass. "You Americans went ahead with amazing speed and efficiency," says Whittle. "In less than a year you had a twin-engined jet plane in the air—the Bell *Airacomet*."

Whittle stayed three months, registered as Wing Commander Whitely, but even that name which he picked because it was so near his own was too hard for him to remember. The hotel staff was constantly puzzled by the different names he signed—to say nothing of the baffled FBI man who lived across the hall, and the same waiter who kept turning up at any hour of the day or night. "I thought at the time it was odd that he was always popping up," Whittle recalls, "until I was told he was from your FBI, too." END

15 YEARS AGO

FROM the January, 1934, issue of this magazine:

The Grumman FF-1 pursuit plane was the latest acquisition of the U. S. Air Corps. (See photo) It was one of few pursuit planes equipped with retract-

able landing gear. Landing gear struts were so hinged that they swung up sidewise when the plane was in the air. The wheels fitted into the round holes cut in the fuselage for that purpose.

Helicopter developments for the past 100 years were discussed in an article "Will the Helicopter Become the Future Flying Machine?" by Alvin E. Moore, a patent examiner. So far, vertical flying had defied aeronautical engineers (world's endurance record was nine minutes) but Moore stated that "present trends in helicopter design indicated that within the next few years there will be born a safe and efficient vertically rising aircraft—a machine that will change man's customs even more than did the automobile."

A super-airport was proposed for New York City. Designed by an architectural firm in collaboration with Comdr. Frank M. Hawks, the plan called for a series of great dock structures some 200 feet in height topped by a landing field large enough for a fleet of aircraft to land. An ocean liner could dock and land passengers and mail beneath the structure. The entire project was planned to include a shipping, rail and airplane center.

"Joseph Le Brix," a Bleriot monoplane, made a non-stop flight from Floyd Bennett Field to Persia. It was flown by the French pilots, Maurice Rossi and Paul Codos. They estimated that their fuel would carry them to Karachi, India, a distance of 7,200 miles but the actual flight covered only about 5,000 miles.

TWENTY YEARS AGO

Most "ambitious exhibition of aircraft ever staged" was held in the Chicago Coliseum. Seventy-eight planes were on display in the booths of 55 manufacturers and operators. Only four military planes were exhibited. Engines varied from the hexagonal air-cooled 600-h.p. Curtiss *Chieftain* to a tiny Henderson motorcycle engine rebuilt for the Heath *Parasol*.

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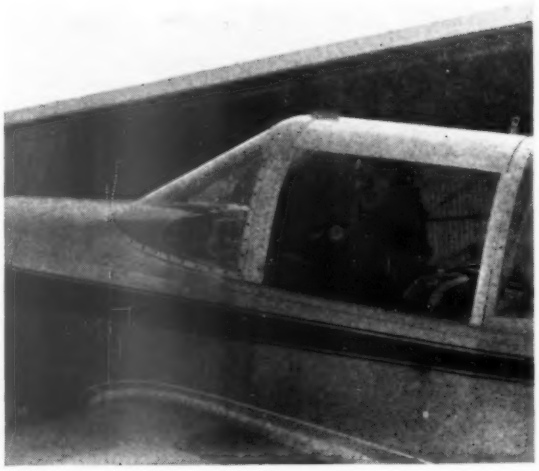

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MONKEY WITH A YEN FOR FLYING

• CHANGE OF SCENERY

Studio technicians did such an excellent job of camouflaging a small East Los Angeles airport into representing a midwestern town's airfield for scenes in the movie, "Weep No More," that two student pilots from San Diego spent an extra hour buzzing the field before the control tower convinced them they should land.

• IT'S EASY—SEE?

Navy Lieut. Gerald H. Wilson was showing Student Pilot Aristedes A. Mascarenhas of the Brazilian Air

Force what to do in case of an upside-down spin. In the middle of a sentence, he accidentally hit the safety belt catch, plummeted out of the plane, parachuted to earth.

• RIGHT BANK, AHEAD

Traffic signs are familiar on the highways. But at Pluckemin, N. J., Somerset Airport has installed traffic signs for pilots. Placed off the side of the runway, so pilots will be unlikely to hit it with a wingtip, the sign guides pilots away from an area where airplanes aren't wanted.

Grover C. Greimes of Seattle, Wash., flew into a high tension wire recently, damaging his prop and shearing off his rudder. Greimes calmly continued on his flight and landed his plane without mishap, steering it by opening and closing the doors.

• PULL OVER, BUB

Richard J. Koester may be the first reckless flyer in history to be thumbed to the curb by a traffic cop. At Pontiac, Mich., State Trooper Henry DeLooff watched Koester "take off like a cowboy" in a rented plane. Trooper DeLooff commandeered a plane, stayed in the sun so Koester couldn't see him and watched him buzz two populous areas. Then he came alongside, ordered the flyer earthward with the standard cop's thumb, saw him pay a $30 fine.

When Walter D. Skaggs, an Oklahoma A & M College student, became the father of a boy, he bought 15 boxes of cigars, got into a plane, and dropped them over his neighborhood.

• DESTINATION UNKNOWN

Cpl. Lee Orange, a GI stationed in Alabama, wanted leave to see his newborn son in Carnegie, Okla., but was turned down by his officers. So he stowed away on a C-47 he believed headed for the West Coast. When the ship proved to be going north, he bailed out over Tennessee, fell into the hands of police, and was turned over to the MPs.

• DOWN TO EARTH

Pfc. John D. Carney was floating leisurely to earth during a mass parachute jump at Fort Meade when he saw a helpless buddy plummeting through space. Carney reached out, grabbed the soldier, and held onto his unopened chute until both were safely on the ground.

• MONKEYSHINES

A monkey with a yen to travel stowed away on a Pan American World Airways Clipper and flew from Panama to Miami recently.

The marmoset, hardly bigger than a kitten, hid among clothes in a suitcase carried by Russell Gordon of Miami, Fla.

• COWBOYS

In South Dakota, flyers Gail Coe and Elmer Bekken spotted a coyote.

Swooping low, they herded the animal into a plowed field, hit it with the tailwheel. Then, landing the plane, they lassoed the coyote with the plane's tie-down rope.

—Harold Helfer

Atomic Engines

(Continued from page 22)

are then used as the propellant. Since the propellant is the result of the combination of at least two atoms, its molecular weight will be fairly high. If hydrogen and oxygen are used, the resulting propellant is water vapor with a molecular weight of 18. If nuclear energy is used to provide the higher temperature, there is no need for the process of combustion and a very light propellant, like hydrogen, with a molecular weight of 2 can be used. The specific impulse of pure hydrogen at the same temperature is three times that of water vapor.

Many of the problems which lie in the path of the practical realization of atomic aircraft power plants are connected with the use of high temperatures. Unlike chemically fueled engines, high thermal efficiency is not the primary reason for wanting high temperatures in a nuclear engine. Specific fuel consumption is of vital importance in a chemically fueled engine. However, for a fuel with a heating value of 40 billion BTU per pound (like uranium), specific fuel consumption is vanishingly small, from a performance standpoint, and thermal efficiency in itself is not a primary objective. High performance is, however, and high performance calls for high operating temperatures. For instance, a high thrust per pound of airflow per second is required in turbo-jets for high-speed airplanes. This requires a high energy input for each pound of air and, therefore, a high air temperature.

The temperature problem is aggravated by the heat-transfer problem. We actually are taking a long step backwards along the road of development in the light-weight engine. The great advance in light-weight design, which made the automobile and airplane possible, came to pass when it was learned how to avoid transferring heat through walls, as in a boiler. In other words, with the advent of internal combustion.

In a nuclear engine, the heat is generated in the solid portions of the reactor and must be transferred to the working fluid through heat-transfer surfaces. Fortunately, we have learned a lot about heat transfer in the past 50 years so we are not starting quite as far back as the men who did the initial development work on the gasoline engine.

One basic fact remains, however, and that is that the internal surfaces of the reactor must be at a temperature higher than the highest temperature of the working fluid, since heat must flow from the reactor into the fluid. It can only flow if there is a positive temperature difference. This is very different from the internal combustion engine where, as in the automobile, the cycle temperatures reach 4,000° while the internal surface temperatures can be kept down to around 500° by external cooling. On the other hand there are no moving parts in the reactor and the reactor elements are not subjected to the high dynamic stresses which are encountered in such parts as pistons, valves or turbine buckets. It can

be said broadly that the temperatures necessary for the realization of an atomic engine are not unreasonable from the metallurgical standpoint, but they do nevertheless engender a number of difficult problems.

One of these problems is the protection of the uranium in the reactor against corrosion by the working fluid and, conversely, the prevention of the escape of the radioactive fission products from the reactor into the working fluid. This is a problem of diffusion and diffusion rates generally go up with increasing temperature. The development of adequate canning for the high-temperature reactor elements is, therefore, a major problem.

Another crucial problem, as in any aircraft, is weight. In an atomic engine, it is necessary to use large amounts of mass to stop radiations emitted during the fission process. A comparison with a conventional airplane can help us visualize the magnitude of the weights which may be allotted to shielding. The weight of the propulsion system comprises, substantially, three major items: the power plant proper, the fuel and the fuel tanks. In the nuclear aircraft, these correspond to the "engine" (compressor-turbine assembly in a turbo-jet), the nuclear reactor and the shielding.

The "engine" component of the nuclear installation may be expected to weigh approximately the same as a conventional power plant of the same horsepower or thrust rating. The weight of reactor and shielding is therefore equivalent to the weight of the fuel and fuel tanks in a chemically fueled aircraft.

The percentage of the airplane gross weight which can be allotted to fuel and fuel tanks, or to reactor and shielding, depends primarily on the structural refinement of the airplane. In present-day long-range airplanes, it represents a very high percentage of the gross weight and is, in some cases, well in excess of 50 tons. It is therefore obvious that the problem of an atomic-powered airplane is in an entirely different category from the problem of an atomic-powered automobile, although they have often been mentioned together in discussions of atomic energy.

Not only the absolute weight of the shielded reactor is important, but also its specific weight, or its weight per unit of thrust produced by the power plant. The weight of the shielded reactor is tied in with the gross-weight of the airplane by structural efficiency. The aerodynamic efficiency of the plane, the ratio of lift to drag, ties in the required power plant thrust with the airplane gross weight. The required lift is equal to the gross weight, while the resultant drag must be overcome by the power plant thrust. By combining these relationships, we arrive at a formula which ties in the power plant performance with the aerodynamic and structural characteristics of the airplane: the specific weight of the reactor must be less than, or equal to, the lift-to-drag ratio times the ratio of permissible reactor weight to airplane gross weight. The range of an atomic-powered airplane is practically unlimited and is not a design variable.

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Shielding weight is influenced about equally by two entirely separate variables. One is the size of the reactor core around which the shielding must be wrapped. The other is the thickness of the shielding itself or, more precisely, the mass thickness needed to stop gamma rays and neutrons emitted by the fission process.

Making the reactor small is an obvious way of reducing weight of shielding. However, it means releasing energy at a high rate in a small volume. Although a nuclear reactor can potentially generate heat at a practically unlimited rate, this heat must be conducted from the interior of the fuel rod to its surface. It must then be transferred from the surface to the working fluid, meaning high temperature differentials, high pressure drops, large internal surface areas and all other difficulties associated with high power densities. Furthermore, the smaller a reactor is, the larger the ratio of its surface area to its volume and the easier it is for neutrons to escape without causing new fissions. A smaller reactor may therefore require a larger investment of uranium in order to sustain the chain reaction and this may prove undesirable from an economic standpoint.

As far as mass-thickness of the shield is concerned, the best materials for stopping a given type of radiation of a given energy are relatively well known. However, the radiations emitted by a nuclear reactor are of two major types, neutrons and gamma rays, each covering a wide spectrum of energies. As they pass through the shield, these radiations gradually change their character. The fast neutrons slow down by successive collisions with nuclei of the shield material; the gamma rays are absorbed and in turn softer X-rays are emitted. A material which is good for stopping gamma rays may not be the best when gamma rays and neutrons are considered together, and a material which is good for the innermost part of the shield may not be the best for the outer layers. There is, therefore, considerable room for weight reduction by ingenious design.

Since we are dealing with a relatively thick shield surrounding a relatively small reactor, the apparent paradox holds true that, for a given mass thickness, the greater the density of the shielding material the lighter the shield. If the density of the shielding material is doubled and the thickness of the shield is cut in half, the volume of the shield is decreased by considerably more than a factor of two and the total weight is reduced accordingly.

From the point of view of conventional power plant experience, shielding may be used as a good example of some of the unusual aspects of nuclear engineering. If two inches of lead reduce some radiations to one-tenth their original intensity, four inches of lead will reduce them to one-hundredth, and six inches to one-thousandth of the original intensity. The radiation intensities encountered in nuclear reactors must be reduced by factors of many billions before they are safe for humans.

A good reflector may turn back as many as 90 per cent of the neutrons escaping from the reactor. It would be wrong, however, to assume that this would solve nine-tenths of the neutron shielding problem. It is more likely to represent only about 10 per cent of the job. In addition, it is very important to prevent the escape of seemingly small amounts of radiation through joints or seals in the shield around the reactor.

The choice of materials for shielding also presents unusual problems. Existing reactors mostly use large quantities of concrete for shielding, but concrete is hardly a suitable aircraft material. The effect of intense radiation on the properties of the materials must be considered too. It has been found that the electrical resistance, the elasticity and the heat conductivity of graphite all change with exposure to intense neutron radiation.

The atomic powered airplane must be designed for very high speeds to take advantage of the special characteristics of atomic power. It certainly will be a large airplane. It will have to be designed for a landing weight which is equal to take-off weight, since practically no fuel will be used up in flight. Because of radiation, the crew locations should be placed as far away from the power plant as possible. That would permit some weight saving in the shield.

Structural requirements will be somewhat different from those of conventional airplanes, since the fuel load will be concentrated in one spot in the reactor, rather than widely distributed. In this respect, however, the atomic airplane may not differ much from some of the thin-winged, high-speed airplanes now under development which do not use wing tanks.

These are some of the problems associated with the development of a nuclear aircraft power plant. They are not insurmountable problems, but such a development is not by any means an easy one. END

MRS. AMERICA IS A PILOT

MRS. AMERICA—beautiful 21-year-old Maria Strohmeir—has kept pace with the air age since she was 17. As a teen-age model in Philadelphia, she spent her earnings on flight lessons. Today, she and her husband have one major ambition: to fly around the U.S. in their own airplane.

When she expressed the desire recently on a radio show, Universal Pictures and Aeronca Aircraft Corporation promptly gave the young couple the opportunity. They spent several weeks touring the nation in a new Aeronca *Sedan*, promoting Universal's forthcoming movie, "You Gotta Be Happy."

Incidentally, Maria's romance and marriage began at an airport, where she met her husband. They honeymooned in an Aeronca *Champion*, and now both the Strohmeirs (they hold private licenses) are trying to wangle a chance to make a parachute jump!

More interesting than those of the planes she flies, Maria's specifications read: Height 5'6", weight 120, bust 35, waist 25, hips 36, thigh 20, ankle 8.

A regular FLYING reader, Maria has saved copies of the magazine for the past four or five years.

The Air Force Moves on Its Feet

(*Continued from page 33*)

the same sort of support (though less elaborate), as the big planes. That gives us about 20 more for *each* of our original 100.

Let's see now: where are we getting to? We made each of our 100 men a bomber commander; and found that he needed 60 other men for assistance in keeping his plane in the air. That's 6,000, all intimately connected with the operation of the 100 bombers.

There are some other jobs a little more remotely connected, like the maintenance of the runways, field lights, etc., the storage, fusing and loading of bombs and rockets, the repair of radio and radar equipment, and the administration of the base. Add another 20 for each bomber, making 8,000 total.

Now, we've long been accustomed to the idea of air support for ground troops, but here is where we need ground support for airplanes. Our base may be attacked by enemy aircraft, ground troops or naval forces. We need antiaircraft guns, ground defense troops, and perhaps PT boats. This will double everything so far, to 16,000 men.

For the present, we'll let it go at that and see what it adds up to. Returning to our original 100 men on the island, you will remember that by the time we finished feeding, clothing, guarding, doctoring them and so forth, we had added 50 per cent. So now we must do that to our 16,000, making a new grand total of 24,000 men. That is the animate part of the body of our expedition. It will fill 12 Victory ships very uncomfortably.

For the inanimate part, we could go to great length without being very entertaining, but let us take a couple of the larger items.

A bomber is not very effective unless it has bombs. If they are atomic bombs we shan't need very many, nor shall we have many available; but they will need very elaborate arrangements for transportation, storage, fusing, loading, etc., and will present a supply problem out of proportion to their weight and bulk.

If the bombs are of conventional type, the quantity will be huge. Do you remember all the thousand-plane attacks upon German cities? It takes thousands of tons of bombs to destroy the military potential of one city.

To get the bombs to their target, the airplanes must fly; so that brings in another element—fuel. A medium bomber burns at least 300 gallons of gasoline each hour that it is in the air. If 100 planes fly for 10 hours on a bombing mission, they burn 100 times 10 times 300, or 300,000 gallons. At seven pounds to the gallon, that is 2,100,000 pounds, or about 1,000 *tons* of gasoline for a *single attack*.

Then there is the matter of food, clothing, personal equipment and household supplies for our 24,000 men.

These are the bulky things but there are also many small and particular things: gauges, meters, special tools and the hundreds of thousands of spare parts necessary for maintenance of aircraft and trucks.

Altogether, these things add up to about 2½ ship tons per man to begin with and 1½ ship tons per man per month for resupply.

Let's get that straight again. Before we can profitably fly our 100 bombers and their crews to a trouble spot anywhere in the world, we must send twelve Victory ships full of troops and six Liberty ships full of supplies, and we must be prepared to follow this up with four ships every month to keep them supplied.

Is that, at last, the whole business?

Maybe yes and maybe no. We have landed these people and their planes and supplies on an uninhabited island, but we have assumed that there are docks, warehouses, airbases and barracks ready and waiting for them. If there are not, we had better go back and start over again because it's going to take about four shiploads of engineers and engineer equipment to build them, and they will have to start six months in advance.

"But why bother with all that?" you are probably saying with an annoyed frown. "We don't want to fight a war—we just want to let them know we mean business."

That is what we would do if we meant business. The enemy would know that and he wouldn't be frightened by our bombers. He would watch our foot. —END

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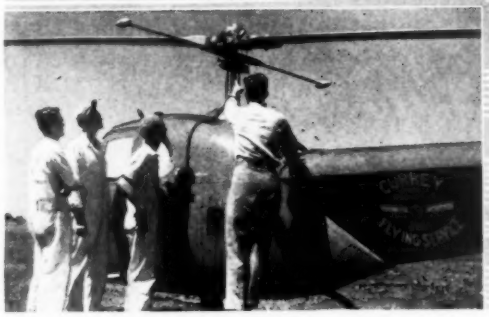

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FOUR-ENGINED LIGHTPLANE

A LIGHTPLANE "airliner" for executive transportation is undergoing CAA tests near New Orleans. Probably the first four-engined craft of its kind in the world, the all-metal Monsted-Vincent *Star Flight* is designed "to give businessmen the same dependability and flying range that airlines give to their passengers."

The five-place plane is powered by four Continental 85-h.p. engines and has Sensenich fixed-pitch propellers, but its builders plan to use a higher horsepower lightplane engine (possibly a Lycoming 115-h.p.) and a two-position Sensenich prop in later models.

The new craft grew out of a wartime dream of Col. Farley Vincent, onetime air liaison officer for the Army Ground Forces in Washington. Vincent proposed to build an inexpensive plane that would offer "more dependability than single-engined executive aircraft." Mulling over the idea, he hit upon the four-engine possibility, and in conjunction with Col. Robert M. Monsted a former Air Force officer, organized Monsted-Vincent Aeronautical, Inc. Headquarters of the new aviation company are at 325 North Hennessy in New Orleans.

Present performance figures on the prototype which first flew Oct. 1 are expected to be improved in the later versions, which will contain the more powerful engines and two-position propeller.

Cruising speed currently is 145 m.p.h., but "over 150 m.p.h." is sought in the future models. With 172-gallon integral tanks (located in the outboard section of the wings), the *Star Flight* will have a range of approximately 1,200 miles (eight hours' flying time), its builders claim.

Gross weight is 5,000 pounds, empty weight 3,200 pounds. It has a 48-foot wingspan and is 34 feet long. The *Star Flight* lands at approximately 60 to 65 m.p.h.

Col. Monsted believes the craft's main appeal will be to businesses or individuals who want transportation that offers "increased safety and dependability over conventional single-engined planes." His company is confident it can produce the four-engined lightplane more economically than the twin-engined planes now on the market.

As the *Star Flight* is not yet certificated, the selling price has not been finally determined. It will be marketed, however, at a price "between that of the highest-priced single-engined executive plane and the twin-engined Beech."

Designer of the unconventional plane is Art Turner of New Orleans, a former Lockheed engineer.

Pearl Harbor

(Continued from page 17)

officer who was on duty at this time "solely for training and observation" did not consider it necessary to take any action. Meanwhile the Opana station had tracked the planes toward Oahu and had lost them.

Two opportunities for an 11th-hour reprieve had been forfeited.

At 0755 single-engined planes were observed southeast of the Hickam Field hangar line heading for Pearl Harbor. Almost simultaneously the naval base and Hickam Field came under attack.

For approximately 30 minutes units of the Pacific Fleet were subjected to the savage blows of wave after wave of enemy planes. It is impossible to determine precisely the sequence of the enemy's actions; they included eight attacks delivered by some 30 dive bombers, low-altitude attacks by more than 20 torpedo planes sweeping across the harbor in four waves, and level bombing from about 10,000 feet by perhaps 15 aircraft. Then came a quarter-hour of comparative quiet. At 0840 horizontal and dive bombers renewed the attack. This action lasted about an hour. At its end the Navy had suffered a most crushing blow.

The battleship force had been most heavily hit. The *Arizona*, *California*, and *West Virgina* had been sunk, the *Oklahoma* capsized, the *Nevada* severely damaged, and three others damaged. Three cruisers, three destroyers, and a seaplane tender had received damages of varying degrees of severity; a mine layer and a target ship had been sunk. Fortunately no carrier was in port. Naval and naval air installations had been seriously hurt. Of approximately 169 naval aircraft in the Oahu area, 87 were destroyed. Tragically heavy too were losses in Navy and Marine Corps personnel, with 2,086 officers and men killed or fatally wounded and an additional 749 wounded.

Although the primary purpose of the enemy had been to cripple the American fleet, it was at the same time necessary for the Japanese to eliminate the danger of an effective reaction from the Hawaiian Air Force. Accordingly, and simultaneously with the initial attack on the fleet, 28 bombers in three waves escorted by pursuits carried out a 10-minute raid on buildings of the Hawaiian Air Depot and the hangar line at Hickam Field.

After a 15-minute lull, the attack was renewed by five or six high-level bombers which fruitlessly bombed the baseball diamond; six to nine others dropped down to 150 feet for a more damaging attack on the No. 1 Aqua System, the technical buildings immediately behind the hangar lines, the consolidated barracks, and on planes parked almost wing tip to wing tip on the warming-up apron. A third attack at approximately 0900 by from six to nine planes scored hits on technical buildings, dispersed planes, barracks, the parade ground, and the post-exchange.

At Wheeler Field, principal pursuit base, the first bombs fell shortly after

0800. Approximately 25 dive bombers approached the field at an altitude of about 5,000 feet, went into a dive, and released their bombs over the hangar line. Within a few minutes the air seemed full of planes circling in a counterclockwise direction but otherwise maneuvering according to no apparent pattern.

Though this attack lasted for no more than 15 minutes, other planes strafed the field shortly after 0900. Bellows Field, third of the major Air Corps installations, suffered less than did either Hickam or Wheeler. Only one plane out of the enemy's first wave of attack, and that a fighter, directed its attention to this field. But nine more fighters came over soon after 0900 to give the field a thorough strafing for about 15 minutes.

In comparison with the havoc wrought by the Japanese planes, the reaction of defending units was pitiful. The enemy had achieved the crushing advantage of surprise. Moreover, under the alert in effect since November 27, AAF planes were concentrated for protection against sabotage, with an allowance of four hours' notice to make them ready for flight, instead of being dispersed in readiness for a prompt take-off.

In the circumstances, it was virtually impossible to put up anything approaching an effective air defense. In spite of handicaps, four P-40's and two P-36's took off from Wheeler Field 35 minutes after the initial attack, and from 0830 until 0930 Army pursuit planes flew a total of 25 sorties. Perhaps the most successful interception was performed by six pilots of the 47th Pursuit Squadron based on the small field at Haleiwa, the only usable airfield not subjected to serious enemy attack. Though not at their base when the attack commenced, Lieuts. Harry M. Brown, Robert J. Rogers, Kenneth A. Taylor, John J. Webster, and George S. Welch succeeded in reaching Haleiwa by automobile and, acting without information as to the number and type of enemy planes, carried out a number of sorties in P-40's and P-36's between 0815 and 1000. Welch alone claimed four enemy planes shot down.

Lieut. John L. Dains, another pilot participating in the action, alternately used a P-36 and a P-40 in three sorties, but on the third of these he was shot down over Schofield Barracks, apparently by antiaircraft fire. On learning of the attack upon Wheeler, crews of the 44th Pursuit Squadron at Bellows Field began arming their P-40's and by 0855 three were ready. But just as pilots Hans C. Christiansen, George A. Whiteman, and Samuel W. Bishop prepared to take off, Japanese pursuits swept over the field in a strafing attack. Christiansen was killed while getting into his plane; Whiteman was shot down immediately after his take-off; and the other P-40, severely damaged, crashed into the ocean. In spite of a wound in the leg, Bishop succeeded in swimming ashore.

At about 0850 four P-36's of the 46th Squadron had taken off from Wheeler during a temporary break under orders to proceed to the vicinity of Bellows Field, near which they attacked a formation of nine Japanese planes. In spite of the fact that the P-36's could not match their opponents in rate of climb, two of the enemy were shot down with the loss of one American plane piloted by Lieut. Gordon H. Sterling, Jr.

Not until 1100 was it possible for Hawaii-based bombers to get off the ground in a search for the enemy's carriers. But the B-17's of the 38th and 88th Reconnaissance Squadrons, which had left Hamilton Field the preceding evening on the first leg of a flight from the United States to the Philippines, arrived over Oahu in the midst of the attack. Unfortunately, the planes had been so heavily loaded with gasoline that ammunition could not be carried, and for the purposes of balance the armor plate in the rear had been shifted forward. As a consequence, the pilots on reaching Hawaii could attempt no more than to escape from enemy fire. Of the first two flights, Maj. Richard H. Carmichael, ranking officer of the 88th Squadron, and Lieut. Harold N. Chaffin brought their planes down on the 1,200-foot runway at Haleiwa; Lieuts. Harry N. Brandon, David G. Rawls, and Robert E. Thacker flew through antiaircraft and enemy machine-gun fire to land at Hickam; and Lieut. Frank P. Bostrom played tag with the enemy almost all the way around the island before landing on a golf course.

The second flight, led by Maj. Truman H. Landon of the 38th Squadron, fortu-

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WORLD AVIATION ANNUAL, 1948, published jointly by Aviation Research Institute, 903 16th Street N.W., Washington 6, D.C., and the James Jackson Cabot Professorship of Air Transportation of Norwich University, Northfield, Vt. Editor-in-chief, J. Parker Van Zandt. 540 pages. Price $17.50.

JANE'S ALL THE WORLD'S AIRCRAFT, 1948, published in the United States in 1948 by the MacMillan Company, 60 Fifth Avenue, New York 11. Compiled and edited by Leonard Bridgman. 570 pages. Price $20.

These two large reference books are essential to any well-equipped aviation library and do not overlap each other in the field of aviation information to any marked degree.

The World Aviation Annual was published for the first time in the latter part of 1948. For researchers and casual hunters after information, it is probably a good thing that it bears the editing stamp of Dr. J. Parker Van Zandt by expressing his special interest in world air transportation and economics.

It supplies detailed information on world and U. S. airlines and air transportation which is available from no other single source. Although it includes historical and service information and plane specification data it is most successful in presenting economic information. The data is organized in uniform sequence. Government organization, service aviation, and history are followed by bilateral agreements, manufacturing, and export-import data. Finally comes data on air carriers, airports, and ground facilities. The information is not designed to help a pilot so much as to provide research materials for students, editors, and desk researchers. Extremely detailed information is provided for American manufacturing companies and air carriers, with less detailed information about foreign companies.

Jane's, the standard book on aircraft for decades, has a different aim than the World Aviation Annual. It devotes some 22 pages to service aviation in 47 countries and 53 pages to civil aviation. But its main purpose is to provide detailed data and specifications on current aircraft and engines. Three hundred twenty-five pages in the book are devoted to that end.

The World Aviation Annual has been called "An American Jane's," but it is not. It is a different kind of book, serving for the most part a different reader demand. Just as Jane's does not begin to present the detail on manufacturing and air transportation, so the World Aviation Annual does not begin to provide the coverage of airplanes and engines that Jane's does—even of U.S. data.

Data in each book is arranged by country, but in Jane's it is divided into four major sections, whereas in the Annual it is all grouped into a single package. An interesting feature of the Annual is an air travelers' guide for each country, giving best traveling time, monitary units, entry requirements, airline service, principal cities and hotels.

—CURTIS FULLER

SHORT VIEWS

WYNDHAM COURSE AND SPEED CHART. Published by Messrs. Edward Stanford, Ltd., 12-14 Long Acre, London, W.C.2, England. Price $1, postage free.

This pocket navigator, clearly printed in colors and enclosed in a transparent wallet, supplies at a glance the following data: (1) Number of degrees to lay off for wind direction; (2) ground speed and time required to cover 20 miles; (3) E.T.A. and fuel requirements; (4) a silhouette of course-to-wind angle, thus preventing double correction; and (5) wind direction in case of a forced landing.

JET PROPULSION IN COMMERCIAL AIR TRANSPORTATION by Robert E. Hage. Published by Princeton University Press, Princeton, N. J., in 1948. Price $1.50.

The material in this book represents a series of lectures in aeronautical engineering at Princeton University. It is devoted to the question, "Can jet propulsion, which has so revolutionized military aviation, be applied in civil air transportation?"

The author reviews the types of power plants which had been applied experimentally to military planes.

In his opinion, a medium-range turbojet transport carrying 25 to 30 passengers and flying at a cruising speed of 500 to 525 m.p.h. is a likely development for use on the routes of major airlines between major cities.

A jet transport with a design range of approximately 1,000 miles would service all domestic runs from 250 to 2,500 miles. A feeder type airplane like the DC-3, however, would still be necessary for short runs of less than 250 miles and within lightly populated areas.

NATIONAL AIRCRAFT BLUE BOOK. Published by National Market Reports, Inc., 900 S. Wabash Ave., Chicago 5, Ill. 1948 Fall Edition, Vol. II, No. 4. Price $7.50 yearly.

This revised edition of the National Aircraft Blue Book contains average appraisal values on all U. S. aircraft manufactured since the inception of the CAA, including the latest models. It is a guide especially prepared for those engaged in buying, selling, financing and insuring aircraft. Essential identification data, horsepower, seating capacity, and original factory prices are given, together with average appraisal valuations.

(*Continued from page 57*)

nately arrived during an inactive period in the attack, but one of the B-17's was badly shot up and two of its crew members were seriously injured. Considering everything, the bombers suffered surprisingly little damage. A final accounting showed that of the 14 planes which left Hamilton Field, two had turned back early in the flight. Of the 12 which reached Hawaii, one had been destroyed and three badly damaged.

Through the remainder of the day, P-40's, P-33's, O-47's, A-20's, B-17's, and B-18's continued a fruitless search for the enemy's carriers, flying a total of 48 sorties between 0930 and 1520. The aircraft warning system had been put back into operation shortly after 0800, but could provide no assistance in this effort. Apparently the course of the invaders plotted earlier in the morning was not utilized as a clue to the probable location of the carriers.

It is now known from enemy sources that Japanese flyers of the first attack wave had returned to their carriers by noon, and that within two hours thereafter all but 29 of the planes sent out against Hawaii had found their way back. But as the day advanced the sea had roughened, and approximately 50 planes were smashed in landing, with 20 or more representing a total loss. This was a small price to pay for the damage done to the Americans.

In addition to the losses suffered by the United States Navy, 64 of the 231 aircraft assigned to the Hawaiian Air Force as of December 7, 1941, had been destroyed, and no more than 79 of the remaining planes were reported as usable. At Hickam Field some of the more important administrative and engineering files, the base repair section, and the overhaul and assembly sections of the Engine Repair Branch had been wiped out. Test equipment, about 75 per cent of the equipment of the Aero Repair Branch, and more than half of the depot property stocks were destroyed. AAF casualties, especially at Hickam Field, were heavy, reaching a total of 163 killed, 43 missing, and 336 wounded.

Except for two carriers dispatched for participation in the attack on Wake Island, the enemy fleet returned to the Inland Sea of Japan. Japanese officials interviewed after the war indicated that they had at no time contemplated a landing in Hawaii. The major Japanese drive, as had been anticipated by the associated powers, would be directed against the Netherlands East Indies and the Malay Peninsula, and in its course would absorb the American-held Philippine Islands. That drive would not be impeded by an American fleet based at Pearl Harbor. The enemy's victory had been perfect as few military operations are.

Nothing in the record indicates that the story would have been substantially better had airmen been in full control of their own forces, whatever minor differences that might have meant. Wherever the fault lay, the AAF in Hawaii, and the fleet whose defense was its chief mission, suffered an overwhelming defeat. END

The Zero Reader

(*Continued from page 19*)

an extended evaluation program conducted by our group among the member airlines it was the consensus that the Zero Reader was the smartest innovation in instruments in at least a decade. Some pilots who flew it said "two decades."

What gets the pilots most about the Zero Reader is that it is so simple. So simple in fact that about 75 per cent of the pilots who have flown it to date are sure that they are being fooled. Some searched about the plane at first to find some strange remote circuitry rigged up by the engineers.

"Manual approaches on ILS just ain't that easy," they say as they climb out of the seat after coming down the beam like a kid on a sliding board. But it is easy, and I'll tell you why.

First off, there has been a widespread recognition since the early days of ILS that better cockpit indication is needed. Various agencies and manufacturers have attempted to obtain this improvement. Failing in this, Sperry came out with its automatic approach system which is being used by certain airlines especially eager to obtain lower minimums. The problem of making precision approaches manually still persists.

Sperry, cognizant of the common complaints, rejected many an idea for a new indicator. Finally they began to add data to the cross-pointer meter. To the vertical needle, which indicates the localizer signal, they added gyrosyn compass signals. This, they felt, would permit the pilot to hold the localizer pointer on zero (or center) at all times during instrument approaches on the ILS. They were right, for in practice this meant that a "fly-left" signal on the conventional localizer pointer would be neutralized by a compass heading change to the left.

It was only natural that they then added to the glide path signal needle an additional pitch attitude signal from a vertical gyro. A "fly-up" signal was then neutralized and zeroed by a nose-up pitch attitude signal from the gyro.

Hundreds of experimental approaches told them that they had something there. But it also told them they didn't have quite enough. Going back to this localizer needle they decided to add a dash of bank. It was here that things really began to cook. With the addition to the vertical needle of a bank signal from the vertical gyro, the vertical needle provided additional anticipation of the ILS beam. So long as the pilot kept the vertical needle on zero the plane would curve nicely into the beam without overshoot or hunt. This was really bringing the pilot out of the wilderness.

Let's take another look at this Zero Reader. It was recognized that the combined data operating the needles of this simple two-element indicator was all that was needed to fly cross-country under instrument conditions. With the localizer and glide path signals turned off, the Zero Reader gives all the necessary information from the gyro horizon, directional gyro and compass to permit manual actuation of the controls with no mental effort. Here, in the simplest package, is roll attitude, pitch attitude and gyrosyn compass heading change.

From this point on things came easy, and the Zero Reader in its present form has switches whereby references in addition to roll, pitch and compass heading change are available to the pilot. On the horizontal pointer there are altitude and glide path. On the vertical pointer there are localizer, VAR and VOR. Yes, it's a simple package but you can see it's loaded.

Combining these signals was sort of a neat trick too. When separate signals (like localizer and gyrosyn, for example) were combined into a composite signal, such things as the airplane's response, the human pilot's interpretation and reaction time, control surface deflections and control surfaces were calibrated into the instrument. Thus when a poor critter like a pilot sees the vertical pointer of the Zero Reader moving slightly to the right, he just moves his wheel slightly to the right as if he were following it. And, believe me, the pointer returns immediately to zero with no overswing and no anticipation on the pilot's part.

In other words, all the interpretation, anticipation and bracketing which requires skill is accomplished automatically in the calibration of the Zero Reader. Some bright lad called the Reader a Moronoscope. Any moron can fly it.

So let's go flying.

While we're warming up, there's the Zero Reader indicator. Vertical and horizontal needles, always perpendicular to each other, move side-to-side and top-to-bottom respectively. The red flags "show" when power is not on the Zero Reader and if the vertical gyro has not completed its erection cycle.

This small instrument next to it is the heading selector. When you set the double pointer by turning the knob on the selector, you can choose whatever compass heading you want to fly. The thin pointer shows your actual compass heading at all times, and since it is a Gyrosyn compass signal it supersedes the old-fashioned directional gyro. You know accurately where you're heading.

Now here on the panel is the selector switch where you select the desired radio tracks to follow with the Reader, or where you can add glide path signals for approaches or constant altitude control for cross-country flying.

Just to show you how darned easy it is to fly the Zero Reader we're going to pull out all the stops on this flight—we're going to do everything with it.

We're aligned with the take-off runway (see diagram), and we set the heading selector to the runway heading of 60°. We take off and climb out over the localizer transmitter shack with the Reader switch on "flight instruments."

As long as we hold the Reader on zero we maintain a compass heading of 60°.

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Now we're picking up the back course of the localizer. We switch to "blue right." ("Blue right" and "blue left" is the manner of designating right—left sensing of a radio beam.) By zeroing, we place our aircraft accurately on the beam. To set the climb attitude, we adjust the pitch trim on the horizontal needle of the indicator. Note that the altitude control switch is off.

Yep, the first thing you know you're remarking how easy the thing is to zero. Easy, real easy, duck soup.

Now we've got enough altitude to turn around. We set in a 180 turn on the heading selector, and switch back to "flight instruments." Let's see, 60 plus 180 is 240—heading 240°. That vertical needle starts to get away as we start our turn and we zero it. We keep it zeroed in the turn, and the signals going into the Reader are such that a bank signal of 20° zeroes the indicator. Soooo, by keeping zeroed we make a smooth 20° banked turn and smoothly roll out on a compass heading of 240°.

A look outside finds us passing over the airport flying outbound parallel to the localizer course. By now we've reached our desired altitude of say 2,000 feet. We level off and turn "on" the altitude control. This by-passes automatically the climbing altitude trim we set in during the climb. Now the altitude will be accurately maintained at 2,000 feet as long as we zero.

Okay, let's switch to "blue left" on the localizer signal. Keeping zeroed, we smoothly "S" over onto the localizer beam outbound. We fly along on the beam until we have sufficient distance from the runway for a letdown. Sure, we're going to make an approach.

Normally, an involved, time-consuming procedure turn would be required to get us turned around and headed toward the runway. Not so with the Zero Reader. We simply set in the runway heading (60°) and switch to "blue right." We then initiate a turn (in either direction depending on local airport procedure) and zero the indicator by banking the airplane to 20°. We continue to keep the little gidget on zero. Near the completion of the turn we roll out smoothly on the beam without overshoot. We merely keep zeroed this whole time without a procedure turn or bracketing. Imagine it—no procedure turn!

As we approach the airport, the glide path pointer of the ILS cross pointer meter starts to move down toward the center. We're still at 2,000 feet because the altitude control has been on all this time. As the glide path pointer nears the center on the ILS meter we switch our Zero Reader selector switch to "approach." See, the altitude control switch automatically drops to the off position.

See for yourself—by keeping zeroed we follow the glide path and localizer with practically no effort whatever. Once on the 2½-degree glide, we reduce the throttle setting to keep airspeed at the desired value. The gear and flaps have already been set. From here on we check the marker beacons and the sensitive altimeter to determine our progress toward the runway ahead of us.

As we near the runway (and I haven't missed one yet on the Zero Reader) the increase in localizer beam sensitivity is barely noticeable because the Zero Reader indications are two-thirds gyro signals. That means no oscillation like you encounter while trying to follow the standard ILS meter. Just zero those simple needles brother, and you're in.

Now in case you missed the point on this flight, I'll add that you don't always have to stay precisely on zero. If you look away to do something else you simply re-zero when you look back. When you get down to 100 feet or so you hold zero as accurately as you can. And, I repeat, that's easy.

Another thing. Did you notice that as we passed the middle marker, the compass pointer read slightly "left" of the setter? Well, this told us that we had a slight cross wind from the left and that we were displaced slightly to the right of the beam and were crabbing left into the wind. That angle between the compass pointer and the setter was our crab angle. By rotating the setter to the left to coincide with the compass pointer, and then re-zeroing, the aircraft edged over to reduce the track error to zero.

Simple? Yes, but we've never been able to do it before flying manually.

And like I've said, any navigational radio aid such as VAR, VOR or computer which utilizes a track error indication like the cross pointer may be fed into the Zero Reader for airway flying and traffic control. Whatever radio signal you have tuned and/or switched in will be engaged into the Reader when you turn to Blue Left or Blue Right.

I'm hot for this new instrument, and the more I flew it on instrument approaches, the hotter I got. When attempting an instrument approach on the conventional ILS system, I have to do a good job of guessing now and then. When my aircraft wanders off to one side of the localizer track, or when I find myself above or below the glide path, I have to guess how far off I am and then refer to my other flight instruments and make a correction in heading or rate of descent.

It's awfully easy to over-correct or not correct enough. If this happens too close to the end of the runway, it's impossible to get back on the track. Abandon approach. Try another, my good man.

For the benefit of skeptics, I have observed novice pilots with no instrument flying experience make very precise instrument "let-downs" under low weather conditions after a few minutes practice with the Reader. I am talking about *Cub* pilots. Names and addresses on request.

Forgive me if I don't get critical of ILS and GCA. Writers who fly poorly and flyers who write poorly and good flying writers alike have tried to do them both in. They won't be done in because we need all we can get to help in all-weather flying. I'm just saying that the Zero Reader will make ILS and GCA much better systems. On GCA, for example, I'm anxious to try setting on the heading selector the exact headings given me by the ground control operator. Give me GCA headings, you down there, and I'll zero them on the Reader.

Now that I'm near the end of this piece, let me say I'd rather fly. But before I go, I want to make a nomination for a flight instrument grouping, see illustration on page 18. Give me this panel, heck, give you this panel, and I'll bet you can instrument fly from here to the next election. And based upon the last one, that's going some.

Sperry thinks I'm over-enthusiastic about the Zero Reader, but I can see in its widespread use the long-awaited chance to clean off some superfluous instruments from the panel. For a long time we've been adding instrument upon instrument and never taking any of them off. But the Zero Reader can do so many different things that it is destined to replace a number of instruments that have added to our cockpit clutter. For a long time the instrument flying problem has been mainly one of how to present the information that we need. Now it can mostly be presented with the Reader.

A few paragraphs back I mentioned that all the instruments I needed for all-weather flying were the Zero Reader, the sensitive altimeter, and the airspeed. Some of the other instruments must be retained but only as monitors in a stand-by or secondary flight group not wholly essential to actually flying the aircraft.

When's the Zero Reader going to be available? They tell me that production designs have been completed, several prototype models are being made for type testing, tools are under way. In short, it looks like a year until they'll be available in any quantity. Type tests take time. Sperry says they'd rather be right than be early, and when it comes to precision instrument manufacture, they've got something there.

I'd say they also have something in the Zero Reader. END

AVIATION'S ALPHABET

THE GOVERNMENT'S not alone in its addiction to using alphabetical designations to simplify long names and terms. Every day in aviation you encounter abbreviations standing for common terms or well-known groups. If you're a pilot, you should score 100 per cent. For non-pilots, 75 per cent is excellent.

1. ALPA
2. ETA
3. CAVU
4. CFR
5. DFC
6. FAI
7. IAA
8. IFR
9. RTCA
10. IAS

ANSWERS: 1—Air Line Pilots Association; 2—Estimated Time of Arrival; 3—Ceiling and Visibility Unlimited; 4—Contact Flight Rules; 5—Distinguished Flying Cross; 6—Federation Aeronautique Internationale; 7—Inspector, Army Aircraft; 8—Instrument Flight Rules; 9—Radio Technical Committee for Aeronautics; 10—Indicated Air Speed.

Your Job in Aviation

(*Continued from page* 28)

However, many others employed elsewhere, notably in the U.S. Weather Bureau, also owe their jobs largely to the growth of civil aviation. There were, all told, only 1,500 civilian meteorologists employed in midsummer 1948.

Meteorological activities have been steadily increasing in number and scope. Many official reports look to continued development and expansion of meteorological services. Rising military air operations will result in further calls for weather and related data. Thus, while at the moment job prospects in air transportation are not overly encouraging, and may not be much better for some time to come, a number of factors are likely to contribute to the eventual improvement of the situation. In addition to military expansion, there will be, for example, growth of commercial air routes over remote areas in the far north, such as Alaska and Greenland, and over vast ocean areas such as the Pacific. These developments will multiply the need for meteorological information, certainly over the long run. Nevertheless, total employment or that portion of it attributable to aviation requirements, will be only moderately above present levels at best.

With job prospects for trained men in the field of meteorology as a whole now good, it is well that the current demand for meteorologists in aviation itself is not stronger. Although it would have appeared that sufficient numbers were trained during the war, in and out of the armed services, counteracting influences have actually made for a shortage of qualified workers in the over-all. This shortage will be relieved to a considerable extent in the next few years as more and more students, recently numbering approximately 300, complete undergraduate or graduate courses. But the profession had not anticipated any serious overcrowding even before the draft.

MECHANICS

● *Top job opportunities.*

Expanding employment of mechanics —both in the near future and over the long run—will be required by continued airline traffic growth and increased activity in other branches of air transportation. In early 1948, over 20,000 mechanics were employed outside aircraft plants, according to rough estimates. By 1950, half again as many should be working in air transportation. As a result of the expansion in aircraft production and related activities, which is far greater than that in air transportation, hiring will soon become heavy enough to diminish greatly—possibly even to wipe out—the present surplus of applicants for jobs. The draft, too, will have a slight effect in reducing the number of available mechanics. Highly experienced and skilled men may attain a favored position reminiscent of World War II, with no competition in job-seeking and excellent chances for advancement.

Specialists (notably those who are also qualified for general aircraft or engine work) will be in particular demand, especially when the manpower situation begins to tighten.

Beyond 1950, peak peacetime numbers of apprentices and virtually all qualified journeymen should be able to obtain jobs, unless defense plans affecting air power are significantly altered.

STOCK AND STORES CLERKS

● *May double in five years.*

Since the end of the war, the number of stock and stores clerks employed by airlines and in related activities has not risen significantly. It was between 2,000 and 3,000, in round figures, on VJ-day and is still within this range. There is little likelihood that more than double the present number will be on payrolls at the end of the next five years, however vigorous general business activity may continue to be.

The pool of qualified applicants, both with and without experience in the field, is expected to be ample to meet at least short-run hiring needs. Since entrance into the occupation is easy and work is fairly interesting and pleasant, competition for employment usually is strong.

GROUND RADIO OPERATORS AND TELETYPISTS

● *Good chances outside U. S.*

Only moderate rises in private employment may be expected for the immediate future at least, and even that growth depends upon continued vigor in the economy as a whole. At present, however, job chances with CAA are particularly good for persons willing to work in Alaska and other places outside the continental United States.

In the field as a whole, both public and private, job openings are not expected to exceed a few thousand through the early 1950s, including vacancies arising from quits, discharges, transfers, retirements, and deaths. Longer-run prospects of radiomen and teletypists differ.

Although great strides have already been made in the substitution of teletype and related types of automatic equipment for radio facilities, this tendency is likely to continue as are other efforts at technological improvement. One of the resulting developments is to decrease the need for radio operators (generally men) and increase the relative need for teletypists (usually women). On the other hand, the best of the former tend to gain in opportunities for promotion (to supervisory positions, for example) as communications activities and staffs grow and spread out from present centers. Another factor favorable to the prospects for advancement of radiomen is the increasing complexity of communications systems, techniques, and equipment and the vital role which communications development —for instance, radar—plays in the drive for all-weather flying, safety, and economy.

On the labor supply side, the potential surplus of qualified applicants, especially radio operators, is large. Hiring of newcomers is spotty. During the war well over 100,000 men and some women received varying amounts of radio-operator training and experience in the armed services. Relatively few of the wartime

END

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trainees have applied for jobs in this field but the number of interested eligibles has been great enough to provide marked competition in some parts of the country.

This situation is likely to persist indefinitely, despite the 70-group program and the draft. Some of the more highly-skilled and experienced radiomen may be able to compete successfully for jobs in a variety of expanding fields, aeronautical and otherwise, involving their basic skills.

TRAFFIC CONTROLLERS

● *More jobs, stiff competition.*

In mid-summer, 1948, about 1,650 airport traffic control operators and 1,150 air route controllers were employed, a substantial increase over levels at the end of the war. Today's rising volume of airport construction and increasing airport and airway use promise further long-range gains.

Since all air route controllers and virtually all airport traffic control operators are on the Federal Airways Service (CAA) payroll, employment in the occupations is governed largely by the size of Congressional appropriations. Recent Congressional and other reports have recommended increased expenditures for this activity. The 70-group program should be a favorable factor. If general business activity and hence air traffic remain in high gear, it is reasonable to expect a doubling of airport and air route staffs over the next five to 10 years—and modest but steady growth thereafter.

Flexible qualifications for these positions make it possible for the Government and other employers to draw upon a wide variety of military-experienced persons: meteorologists, communication "specialists," air-crew men, and dispatchers; also upon many men and women without military background.

Considering the large number of qualified persons and the interest shown in the traffic control jobs, fairly stiff competition can be expected for most openings.

TRAFFIC AGENTS AND CLERKS

● *Substantial increase expected.*

Employment in traffic jobs should increase both in the near future and over the long run. Early last year more than 10,000 persons were employed in such jobs by the airlines. Five years from now the number should be substantially greater—again, if general business activity continues high.

The largest number of openings will probably be for ticket and reservation clerks. Relative growth, however, may be most rapid in jobs connected with cargo traffic, which now employ far fewer persons than are in the passenger end of the business.

Job chances for newcomers are perceptibly better than they appeared to be early in 1948, bolstered by the general upward trend in employment and by other factors.

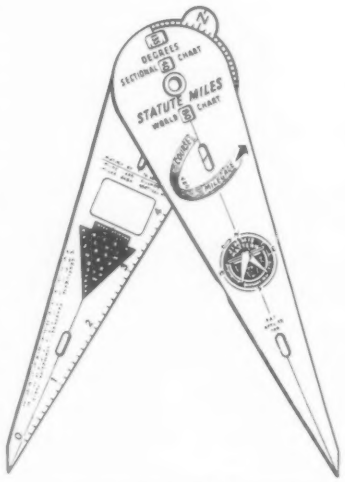
NAVIGATOR'S SHORTCUT

JIMMY MATTERN, famed round-the-world soloist of the '30s, has developed a pocket-sized navigational aid which he claims "provides all necessary flight information speedily and accurately."

Called the Course and Mile-Gauge, the aid automatically shows direct mileage readings for any aerial map, without additional computation, and provides the compass course in a matter of seconds.

It consists of a pair of dividers which can be used either as a mile-gauge or protractor.

When used as a protractor, the instrument is placed face-up on a map while the bottom leg is held with one hand over the meridian so that the pivot hole in the instrument covers the intersection of the course line and the north and south meridian. The top leg is then pointed in the direction of the course to be followed, so that the course line bisects a line-up window in the leg. Degrees are read off direct along the circumference in the window provided and marked for that purpose. Since the top leg can be swung in an arc, encompassing the 360° of the circle, only one position is necessary to get any course line.



When used for miles measurement, the bottom leg of the dividers is held at the starting point and the top leg swung to the point to be measured. Direct mileage readings automatically appear in the windows provided for Regional, World and Sectional charts.

AIRCRAFT MANUFACTURING

● *Greatly increased employment.*

Half a million jobs in aircraft plants, including engine and parts plants, may be expected in the next three or four years or so. As last reported by the Bureau of Labor Statistics, production workers in aircraft and parts and aircraft engine establishments totaled about 165,000 in September 1948; wage and salary workers together numbered upwards of 225,000. The rise in employment from these levels will be gradual and is unlikely to involve a serious manpower problem, except in special instances. Manning difficulties are anticipated, for example, in at least some of the more sparsely populated labor market areas (but with relatively heavy concentrations of orders) and for specialized jobs. To meet the needs generally, however, thousands of the men and women required will come from the ranks of laid-off aircraft manufacturing personnel, long since in other industries or even out of the job market. Thousands more will be available indefinitely from among new, young entrants into the labor force and large numbers of women whose interest in employment may be rearoused. These newcomers and returning women will be recruits not only for the expanding aircraft industry but also to serve as replacements for workers transferring to aircraft manufacturing from other industries. Another source of manpower, especially if the present high levels of general business activity weaken, will be older men. Finally, some increase in hours is fairly certain, with the obvious effect of keeping down the actual number of additional workers required.

It should not be difficult, on the whole, to man the production lines, particularly on the all-important West Coast, where the bulk of plane factories are located. This region has experienced unusually heavy immigration for several years and relatively high unemployment during the past year or so. On the other hand, local, if not general, manpower shortages may be encountered in some few skilled trades and professions, especially in connection with the inevitable expansion of research and developmental programs and facilities. Complaints have already long been heard about the lack of radar and other designing engineers, specialists of various kinds, and mechanical engineers. Peak graduations due in the next year or two which will tend to relieve professional tightness in the more direct manufacturing fields will not favorably affect to the same extent the nonmanufacturing fields. In nonprofessional fields, the supply and demand for such highly-trained craftsmen as tool and die makers is in only delicate balance at best.

● *Effect of the draft.*

As Air Force officials are reported to have indicated prior to the passage of the new Selective Service Act, the draft program is not likely to hamper plane production. Men liable to call will be mainly the young and the least skilled and vocationally-trained. While the removal of such youth from the civilian labor force may have a long-run effect on the supply

of journeymen in apprenticeable trades, including trades essential to air-ship building, the immediate needs of the program for unskilled and semi-skilled personnel (not required to have much, if any training or experience) can well be met from among other groups of workers, notably women. However, a special campaign of recruitment, aimed particularly at obtaining women workers, may be found necessary. END

I Learned About . . .

(*Continued from page* 44)

reporting our predicament. The operator gave us reassuring information, saying if we maintained 3,000 feet on the beam we wouldn't have any mountains high enough to bother on the way into Toledo. That was a load off my mind and I had just taken a deep breath of relief when a mountain loomed out of the snow! Acting almost on reflex I banked the plane steeply to the right and missed it.

Then the radio antenna loaded up with ice. No more reception. It was completely useless. We were on instrument conditions—without a radio or turn-and-bank indicator, in a single-engine lightplane.

Norm's voice broke into my concentration. "Hey—look at that compass."

There it was, swinging back and forth. The compass was all right, so far as magnetic compasses go. It was okay when there was some good earth or a horizon to look at. But in this nightmare of swirling snow, and without a bank-and-turn indicator, it was useless. We were on a north heading, and wanted to turn west. I gave her left rudder and left aileron but the compass card beat me around and read east. Then I gave her a little right rudder—and the compass said south!

It was cold in that plane—and we were both sweating, the kind of cold sweat that breaks out when you know you're in a spot and don't know exactly how to get out of it.

By this time we had climbed to around 5,000 feet and the ice was getting pretty bad. The snow had almost stopped but fog was pressing from all sides. I was trying to fly with only trim tab and rudder—and not much rudder.

The airspeed indicator held steady. Then it began to creep up. "130 . . . 140 . . . 150 . . ." All the time I was coming up on the trim tab. I decided it must be the ice, so hauled back on the stick. We had lost 1,000 feet, but she finally started to slow up and then level off. Before I could get the trim tab back and down again, the airspeed read below 60 and she almost stalled.

Just at that moment, right out of the clouds less than 500 feet away, came a DC-6 airliner—right toward us! It looked like he pulled suddenly up and to his left—but what probably happened is that we were in a climbing turn to our left, and the airliner didn't even see us.

In a second, the Cessna had started a dive. I neutralized the rudder and stick, and from the feel of things I could have sworn the airspeed indicator was wrong. We were indicating 1,500 feet per minute—down. This time I pulled her out without losing so much altitude.

Every minute that dragged by we became more tense, although Norm had little to say. Just about the time I got the plane leveled out again, the motor revs seemed to be falling off and I pulled on carburetor heat. The engine slowed down a little, then suddenly there was a distinct chug—and the thing almost stopped completely. It jolted along for a while at about 700 r.p.m.s and then the chunk of ice in her throat melted and she took hold again.

"Keep calm—figure things out," I said to myself, and tried to give Norm a reassuring grin. He tried to appear unconcerned—but I could tell the whole thing was bothering him just as much as it was bothering me—and just as much as it would bother anyone else in the same spot.

With a turn-and-bank indicator we might have been able to stop turning and level off long enough for the compass to catch up with us. As it was, we had to fly pretty much by the seat of our pants.

The chart indicated that terrain to the north and west of us was less hilly, so we tried to hold a heading that general direction.

The preceding half hour had been full of erratic flying and considerable experimenting with the controls. Finally, we began to get the general idea of how it might be done—letting the plane do most of the flying itself. We did little talking during the next few minutes. Most of our time was spent in an anxious scrutiny, trying to peer through the solid white.

After about 15 minutes in a general west and north direction, we started letting down. At 3,000 feet we spotted a break in the clouds—and a green meadow underneath! Spiraling through the opening, we found ourselves beneath the overcast at about 1,500 feet. The ice began to melt off the wings.

In a short time, the antenna was ice-free, and we had radio again. That was lucky because we didn't know where we were. We could get a faint N signal on the Toledo beam, so we then turned on the Seattle beam and found we were on the A quadrant. That meant we had to fly east to reach the beam. Hitting it, we headed north and in a few minutes were over Fort Lewis. From there to Seattle was an easy hop. We landed at Seattle-Tacoma airport 2 hr. 15 min. after leaving Boeing Field.

We had been in fog continuously for 50 minutes.

We were flying a single-engined plane and we didn't have sense enough to turn around when we learned we couldn't fly under.

That was on December 31. Can you guess what kind of New Year resolution I made? END

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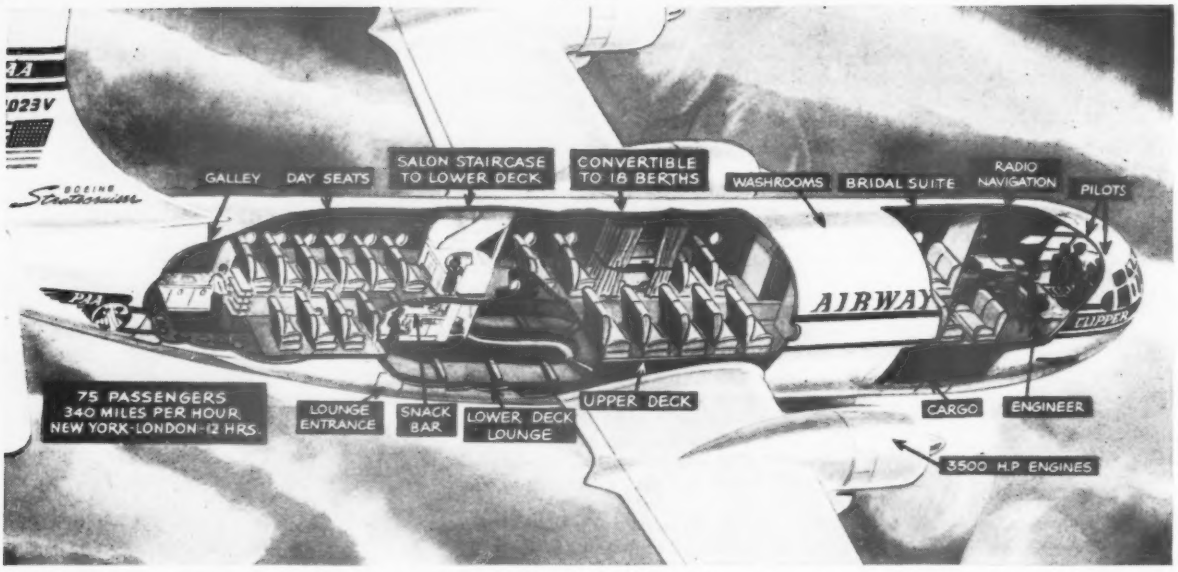

Stratocruiser cutaway shows layout of mammoth two-decked plane. It has both a galley and a snack bar (located in rear of lounge).

Double-Deck Airliner

(*Continued from page 34*)

power "package"—engine and all—can be changed in 30 minutes by four men, roughly a fourth of the time required on other modern four-engined airliners. Interchangeable engines, underwing fueling and let-down ladder-type doors also reduce ground time to a minimum.

Passengers in the *Stratocruiser* will have plenty of room. Seats have push-button chair arm control panels for summoning the stewardess, tilting, or flicking on the individual lights. Passengers can also stroll to the lounge down the circular staircase, drop back and take a look at the $12,686 galley, or spend a few minutes in one of the spacious dressing rooms.

Air pressure is regulated independent of altitude. Warm air can be cooled, cool air warmed, and the entire air content recirculated every 90 seconds, and then filtered, humidified and deodorized. Air inside can be warmed to 70° when the outside temperature is *minus* 70°.

Actually, the *Stratocruiser* is a "sister" of the new B-50 *Superfortress*. It has the B-50's wings, tail assembly, landing gear and pressurization system. Fuselage is that of the C-97, the cargo plane Boeing developed for the Air Force.

The plane's revolutionary nature is reflected in its cost—twice that of conventional 52-passenger airliners. It is half a million dollars more than the *Constellation* which in 1947 inaugurated the first regularly-scheduled round-the-world service on Pan-American Airways.

Fifty-five *Stratocruisers* have been ordered from Boeing and are about to be delivered. Pan-American Airways will introduce the liner on its San Francisco-Honolulu run, and later will put it into service on the North Atlantic route. The other airlines will begin scheduled service with the new planes shortly thereafter.

The *Stratocruiser's* specifications and performance:

Cruising speed.....300 to 350 m.p.h.
Gross weight loaded.....142,500 pounds
Passenger capacity.....
Seats 61-55; Sleeps 24 to 45 depending upon the airline; Lounge seats 12-14
Crew.....Flight crew 3 to 5, plus cabin attendants
Maximum payload.....25,000 pounds
Length.....110 ft. 4 in.
Wingspan.....141 ft. 3 in.
Height.....38 ft. 3 in.
Maximum range.....4,200 miles
Service ceiling.....32,000 feet
Cruising altitude.....15,000-25,000 feet
Engines.....Four (3,500-h.p. Pratt & Whitney R4360 *Wasp Majors*)
Fuel capacity.....7,630 gallons
Cargo capacity.....Two cargo holds, total capacity: 830 cubic feet

With the *Stratocruiser*, transoceanic flight times on airlines will be shorter than on prevailing schedules. For example, PAA's New York-London flight will be 12 hours; San Francisco-Honolulu, 8½ hours; New York-Bermuda, 2½ hours. END

Winter Flying

(*Continued from page 38*)

the chute drain. This dripping fuel is ignited if a backfire occurs. These fires are more frequent in cold weather because of difficulty in estimating proper prime, less efficient vaporization of fuel, and unequal priming of cylinders.

On many planes fires may occur within the carburetor air duct and cannot be seen externally. The carburetor air temperature gauge needle soon hits the top peg during such fires which frequently destroy the temperature unit. Open throttle and turn engine with starter to assist in extinguishing fire. A helper with a fire extinguisher can be useful if he keeps a sharp watch for carburetor scoop fires and acts quickly against ground fires below the aircraft.

Operational hazards increase with lowering outside temperatures. Below —40° standard practices may be reversed. Experienced cold weather pilots know that when it is necessary for a recently landed plane to stay on the line for a few minutes the oil will stay hotter if the engines are shut off and covered. Remember: the in-going oil temperature may decrease at very low temperatures rather than increase until the oil assumes its average temperature at climbing or cruising power.

FUEL FLOW RESTRICTION. Partially-filled fuel tanks sweat internally on the top and upper sides. This results in water drops in above-freezing conditions and hoar frost in low temperatures. As gasoline sloshing occurs, ice particles may restrict or stop the flow of fuel to the carburetor. When the fuel tank is subjected to some engine heat, as in the Piper J-3, water may enter the fuel system in excess of capacity of the sediment trap after considerable operation when it is not possible to drain water in the preflight servicing.

After preheating it is well to check gascolator drain, as water may have been formed by condensation during pre-heating. Whenever possible or feasible keep all fuel tanks filled. When temperatures are well below freezing, little water may enter the fuel tank during refueling, but filtering should not be discontinued because of the possibility of ice crystals and other foreign matter. The old reliable chamois or felt filter is still being used. Bond all metallic units used during refueling. Connect funnel wire to aircraft before placing funnel in tank-filler neck. Fires caused by static discharge occur during cold weather as well as warm weather, though the danger is less.

SKIS. There is no ideal standard ski. A

ski ideally designed for glare ice landings would be dangerous when operated in deep snow. Novices should consult experienced ski pilots.

After a plane has been parked in cold weather it is necessary frequently to slick the skis by taxiing, or scraping off frozen snow before a start may be made. Frequently it is impossible for one man to move the plane, even after a momentary stop. When ski planes have been left parked on the snow it is frequently necessary to dig a series of tunnels to scrape the bottom. To increase the ski slick, shortening the take-off run, it has been found helpful to rub kerosene on the ski bottoms. Taxiing over kerosene-soaked rags retards surface stickiness and allows much faster take-offs. In comparatively loose snow, the frost and snow frozen to ski bottoms may be removed by seesawing a rope underneath the ski from front to rear.

Sticky snow is very deceiving. When water begins to form with the air above 32° the surface is much slicker.

Experienced ski pilots rig their skis to provide an appreciable amount of incidence. This is especially important to prevent them from stubbing their toes when they are "feeling" for the surface under conditions of broad snow and no shadows.

On some shock-cord installations the incidence tension, or shock cord, has been secured to the same upper and lower fittings as the safety line. It's safer to install shock cord and safety line as entirely separate unit.

Whenever possible, parked planes should be left with skis resting on poles or boards to lessen snow adhering to the bottom surfaces.

BRAKES. Pilots should be wary in taking off from snow-slushed runways, as brakes may freeze in subsequent flight, causing locked wheels when landing. A more obscure brake locking may occur when hoar frost or blown snow lodges inside the brake assembly when aircraft are parked in the open. Hard use of brakes generates heat, and the water thus formed may freeze between lining and drum, or in the actuating mechanism.

When water is believed to have formed in this manner, continue taxiing, meanwhile working the brake action without causing friction drag until the brake assembly has again cooled below the freezing point. When possible, avoid use of brakes during taxiing and take-off.

Caution: During low temperatures always use the proper grade of hydraulic fluid. Never leave parking brakes locked when the aircraft is at rest. Hydraulic fluid of too low a viscosity index may cause brake to remain in the "on" position when the operating pressure is released. This may not cause dragging but the brake pedal remains depressed and the brakes therefore are inoperative.

Efficient shock struts are especially necessary on ski planes, since the absence of tires place additional stresses on landing gear assembly. Improper hydraulic fluid in landing gear shock struts has caused accidents due to unequal functioning of the shock struts while landing.

FROST AND FROZEN SNOW ON PLANES. It is dangerous to take off, or attempt to take off with frost or frozen snow on wings, propeller, stabilizing and control surfaces, or the fuselage. Even if the frost layer conforms substantially to the airfoil, the airplane will fly abnormally. Although some airfoils are more susceptible than others and frost formations differ, it is possible for even 1/16-inch of frost to prevent a normal take-off.

At temperatures between zero and 32°, frost or frozen snow can be removed by two persons seesawing a rope back and forth along the wing, fuselage and tail surfaces. It is more difficult to remove frost this way during excessively low temperatures. A dull scraper is used to scrape frost from leading edges and as far rearwards as one can reach. Frost must be scraped entirely from the ailerons.

Propellers must also be absolutely free of frost or frozen snow. On slinger ring installations, check the de-icing fluid discharge nozzles for icing, especially after fire-potting. One frozen nozzle can be more serious than both or all nozzles frozen if ice remains on one blade.

CARBURETOR HEAT. When operating below 20° without carburetor heat, the mixture may not be properly distributed. Some carburetor heat often increases power output due to better fuel vaporization. It is well to experiment with many settings of heat control for the best power. Keep in mind, when using mixture control at altitude, that any movement of carburetor heat control requires a readjustment of mixture control.

OIL PRESSURE GAUGES. When starting engines which have not been fire-potted, oil-diluted or preheated, the oil pressure gauge frequently does not indicate pressure at first but gradually moves to the required indication or beyond. If the engine is shut off at this period, the gauge sometimes remains at a normal indication and may not return to zero. This apparent pressure reading occurs because bearing surfaces are receiving little or no lubrication. Existence of this condition may be checked by momentarily reducing throttle setting from warm-up speed to idling speed, meanwhile noting if a proper ratio drop in pressure indication occurs. If there is no indicated pressure change, congealed oil is present. If propeller pitch can be changed from a higher to a lower setting on two-position, constant-speed or hydromatic propellers it is a fairly safe indication that the engine has oil pressure.

TEMPERATURE GAUGES. Oil temperature gauges are more dependable than pressure gauges during warm-up. When preheated oil is in the tank, the oil temperature gauge should indicate a temperature rise soon after the engine has started, indicating pumpability. Starting with cold oil, the oil temperature gauge will not register a change for a considerable period. Take note of the rate of indicated temperature rise during warm-up, considering the temperature of the oil at starting. Lack of temperature change or a rapid rise indication should

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Steerable Tailwheel Assy., Cub J-3, J-4, J-5; Luscombe 9.30
Fullswivel Tailwheel Assy., for all above & T'Craft, Aeronca 8.10
Rudder Arm, Cub, Aeronca, T'Craft .. .90
Air Phone, Hand Type 3.50
Antenna Reel, Plastic 6.00
Range Filter, Receiver 6.00
Loop, Direction Finder 24.00
Sock, Trailing Antenna ..... .60

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½ Pt. Indian Head Shellac w brush ... $0.50
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be checked. On some installations an overheating engine will record rising temperatures on oil temperature gauges as heat is conducted from the engine, even though the oil is not circulating. Note the reading of head temperature gauge in conjunction with oil temperature.

Maintain considerable power while letting down during sub-zero temperatures to prevent too rapid cooling of cylinder heads. The engine may not "take" throttle, after idling for only a short period. Likewise, do not attempt take-off until the cylinder-head temperature, as well as oil temperature, is at least at minimum specified temperature. Many engines have quit during take-offs because of this carelessness.

There appears to be some misunderstanding about operating aircraft equipped with an oil cooler with automatic regulator and oil cooler shutters. The tendency may be to operate with shutters wide open, knowing that the regulating valve will not permit the oil to go below operating temperature. It appears better practice to adjust shutter to obtain the reverse tendency, that is, to close or partially close shutters so the regulator will permit some warm oil to circulate through the cooler; thus the cooler will be available if needed. Unless warm oil is thus circulated, all oil in the cooler may congeal enough to require heating.

OIL DILUTION. Most surplus aircraft now used commercially are equipped with hopper oil tanks and oil dilution systems. The operator should be familiar with the Air Force technical orders concerning his particular equipment. In estimating the amount of gasoline required in diluting, observation of oil-pressure drop appears preferable to the strictly timed period. Over-diluting can damage an engine but no defects or undue wear are noted in engines where dilution is conducted properly.

RADIO. Below zero temperatures cause radio malfunctioning and often complete failures. Operators should remember these facts:

1. Congealed grease in control shaft housings or gear cases often makes it impossible to operate remote controlled equipment from the cockpit.

2. Dry cell batteries can freeze, making them useless.

3. Excessively low temperatures change capacitance, inductance and resistance of circuits. Re-peaking of transmitters and re-balancing of receivers may be necessary.

4. Equipment may fail when brought into a warmed shop for adjustment or repair and subsequently reinstalled in aircraft before the sweating in the warm room has entirely dried.

5. Rubber, leather, canvas, steel and glass are all more brittle at low temperatures.

6. Motor generators require more frequent inspection. Brush wear is greater because carbon is more powdery. Carbon granules from brushes may lodge between segments of commutator, causing arcing.

INSTRUMENT FLIGHT IN CONTACT WEATHER. When tundras are covered with deep snow and there is an overcast, the horizon disappears and no ground references exist. Under such conditions, the ceiling may be 10,000 feet and the visibility 50 miles, yet it is as difficult to fly as in overcast.

Pilots should be qualified instrument pilots before they try to fly under such conditions.

A LAST WORD. If possible, paint your plane brilliant and contrasting colors. It will help you to be found in case you are forced down.

Always file a flight plan, or tell someone of your proposed course, even for very short flights.

Carry emergency equipment, and don't hesitate to consult experienced cold-weather pilots. Follow their advice even though it may cost payload, range, or both. END

Rose Bowl Game

(*Continued from page 39*)

missions, only 5,000 seats are actually placed on public sale and purchasers usually stand in line for half the night in order to buy these. The Tournament of Roses Association gets 17,000 seats for participants in the parade and the remainder go to the two football conferences. On the day of the game an extra squad of plain clothes policemen is on duty to discourage ticket scalping.

There will be heavy flying traffic over the parade and game again this year. In the air will be at least one blimp to handle surface traffic control, four sign towing outfits, four Los Angeles County Sheriff's Aero Squadron patrol planes, the usual number of Cubs carrying photographers, and a complete squadron of Army helicopters to transport key Tournament of Roses officials six miles from the end of the parade to the Rose Bowl. Captain Sewell Giggers of the Sheriff's Aero Squadron advises all planes to maintain a 1,500-ft. altitude and fly a left-hand pattern in the vicinity of the Rose Bowl during the game.

SOME AIRPORTS SERVING THE ROSE BOWL

AIRPORT (Latitude and Longitude)	Phone Number	Nearest Town and Distance	Number of Runways	Length of Longest Runway	Gasoline Grades	Service Facilities	WRITE TO:
Monrovia 34°08'-117°59'	Monrovia 013	Monrovia 1 mi.	One	2,557 ft.	80-91	Repairs	Bud Hanzer, Manager
El Monte 34°05'15"-118°02'00"	Forrest 89982	El Monte ½ mi.	One	2,000 ft.	80	Repairs	W. H. Livermore, Manager
Rosemead 34°04'15"-118°03'30"	Cumberland 32411	Rosemead 1½ mi.	One	3,200ft.	80-91	Repairs	Jack & Bob Heazley, Managers
East Los Angeles 34°01'-118°08'	Angelus 10747	Montebello 2 mi.	One	3,400 ft.	80-91	Major	Clarence Bergren, Manager
Vail 34°01'-118°08'	Angelus 21173	Montebello 2 mi.	One	3,200 ft.	80-91	Major	W. H. Coffin, Manager
Grand Central 34°10'-118°17'	Charleston 51222	Glendale 2 mi.	One	3,900 ft.	80, 91-100	Major	Hugh Nicholson, in charge, field operation
Lockheed 34°11'56"-118°12'24"	Charleston 67421	Burbank 3½ mi.	Two	6,000 ft.	80, 91-100	Major	L. W. Kuhler, General Manager

Glendale control tower operates between sunrise and sunset on 201 Kc., 120.3 Mgc.
Lockheed control tower operates 24 hours daily on 272 Kc., 118.7, 121.9, and 126.18 Mgcs. Fog indicating blinkers on east end of field (runway 15) with right hand traffic because of nearby hills.
El Monte has 24-hour lights and a rotating beacon. Traffic is normally right-hand.
East Los Angeles is located within the traffic pattern of Vail Field. The sea level pattern elevation for East L. A. is 800 feet; for Vail, 1000.
Monrovia is 30 feet higher at the north end (normal approach) than the south.

Starting time for the parade is 9:15 Pacific Standard Time. If Pacific daylight savings time is still in effect, the parade will begin at 10:15. Game time is 2 p.m. standard time; 3 p.m. daylight time. For an unobstructed view of the parade, between 25,000 and 30,000 temporary grandstand seats are erected along the 5.7-mile line of march. Seat prices range between $3 and $5.

Tournament officials recommend that visitors holding Rose Bowl tickets view the parade from close to the formation area on Orange Grove Boulevard and then walk the one-half mile to the Rose Bowl. Cabs may be chartered for the afternoon but Yellow Cab recommends that any group of four to six visitors rent a limousine for the day—$30 for 10 hours and 120 miles, including a chauffeur.

Housing in the Pasadena area over New Years is skimpy. Of the three largest hotels in town, the Huntington ($24 to $36 American plan per couple) houses up to 80 players, officials and press representatives of the visiting Big Nine team. Manager Steve Royce advises that the Huntington is already sold out for the day. The Green Hotel (singles $4, $5 and $6) handles the Pacific Coast team and Manager Leroy Linnard says there are no vacancies. The Constance Hotel, Manager Joe Donnahue (singles $3 to $5) has also hung the "Sold Out" sign for the day.

Most visitors will rely on out-of-town hotels and auto courts. Since there is no airport in Pasadena, guests must land at one of six or seven surrounding airports. A wire to the airport manager of one of these fields, stating time of arrival, number in party, type and price of lodging required and duration of visit would be the best bet for New Year's visitors. These

airport managers have daily contact with auto courts near their fields.

Many visitors, however, plan to revel all New Year's Eve, then see the parade and game or horse races and leave the congested area before finding lodging.

Restaurants are many and varied in Southern California. Some of the more popular Pasadena restaurants include Fisher's and The Headliner (Fish & Chips from $1.50 for dinner), Gambrinus (Mexican plate from $1.25), Perry's (steaks from $3.00), Hillcrest (prime ribs from $1.65), Sea Food Tavern with dinners from $1.50 and the Huntington Hotel Ship Room with dinners from $2.50. These prices will hold true except where special parties are being held.

Airports closest to the Rose Bowl are Monrovia, El Monte, Rosemead, East Los Angeles (formerly Montebello), Vail, Glendale and Burbank. The one bright spot in the dim housing picture is to be found at Glendale's Grand Central Airport where rooms on the field, for men only, are available in the barracks at the Cal Aero Institute. Manager Jack Beilby always has space for 100 to 150 visitors at 50 cents per night. He can house up to 350 if reservations are made in advance.

Pilots approaching Pasadena from the east through the Banning Pass will find three lightplane fields ringing the area. Monrovia Airport is eight miles from Pasadena. Runway is 2,557 feet long with a 30-foot downhill slant toward the south. Tiedown is 50 cents per night. This airport is only 2½ miles from the Santa Anita Race Track and cabs travel the distance for $1 plus 10 cents for each additional passenger. Monrovia has a small cafe noted throughout the area for its homemade pie. Bud Hanzer is manager.

The El Monte Airport is built on a 35-acre plot in the San Gabriel River bed. It has a single 2,000x100-foot strip and is slightly closer to the Rose Bowl than Monrovia. The field has a rotating beacon and lights all night. The traffic pattern, normally landing to the south, is right-hand to stay clear of the nearby Rosemead Airport. W. H. Livermore is in charge.

Rosemead Airport has a single 3,200-x 75-foot paved runway adjoining an interurban streetcar line. It is located just west of the town of El Monte and tie down is $1. Last year a dozen planes used this field to visit the Rose Bowl. Twin brothers Jack and Bob Heazley operate the field.

Larger planes will find two airports nearby: Vail and East Los Angeles (formerly the Montebello Airport). Both have wide 3,000-foot paved strips with good approaches. Both have lights on request and servicing facilities. The left-hand pattern of East L.A. (the more easterly field) is 800 feet while the 1,000-foot pattern of Vail Field completely surrounds the East L.A. Airport. Clarence Bergren operates East L.A. and W. H. Coffin is in charge at Vail.

For planes coming in from the north, two large airline fields are available close to Pasadena. Both require two-way radio. The Grand Central Airport in Glendale is the closest field in air miles to the Rose Bowl but surface transportation, not counting cabs, is spasmodic. Tiedown for any sized plane, DC-3's included, is $1 at Grand Central. The tower is on 201 kc. and 120.3 mgc. and operates from sunrise to sunset. The single paved runway is 3,900 feet long. Hugh Nicholson is manager, but Jack Beilby usually drives the station wagon that meets all planes.

The Lockheed Air Terminal in Burbank was formerly the home of the airlines for Los Angeles. It boasts two 6,000x300-foot runways, 24-hour lights and complete overhaul facilities. The tower broadcasts on 272 kc., 118.7, 121.9 and 126.18 mgc. Low approach fog lights are in operation on the prevailing NNWxSSE runway and a right-hand pattern is used because of the nearby mountains. Fees depend on the size of aircraft. There is a restaurant and cocktail bar on the field.

Pilots who come to Pasadena on New Year's Day can be sure of seeing the Tournament of Roses parade, but their chances of getting into the Rose Bowl without prior tickets are slim. No reserved seats are required, however, for Santa Anita.

Other year's-end spots of interest include the observatories at nearby Mt. Wilson and Mt. Palomar, Hollywood night clubs, and winter sports at Mt. Waterman, Mt. Baldy and the Lake Arrowhead area.

END

Efficiency Race

(*Continued from page* 31)

Beech *Bonanza* class in last spring's regatta, for instance, was 151.2 m.p.h., and George Pew, president of the Philadelphia Aviation Country Club, won with 154.7 m.p.h. This fall, however, the average speed was 123.9 m.p.h., and J. M. Arner won with only 114.7 m.p.h. Similarly, the Cessna 140 class averaged 99.5 m.p.h. in the spring, as compared with 94.4 m.p.h. this fall, and the Stinson 150-165 class average of 105.9 m.p.h. in the spring, compares with 101.3 m.p.h. in the fall.

Because the overwhelming emphasis now given to gas consumption results in cruising speeds much lower than cross-country pilots would be likely to fly in actual practice, the Regatta committee is considering various suggestions to equalize the formula so that a balanced proportion of speed and efficiency of operation will result. It is also believed that certain minimum speeds may require more from the pilot than does the present formula.

Another factor in the Regatta that determined piloting techniques to a large extent was the requirement that planes round the pylons at each designated point at 250- to 500-foot altitude. This was necessary so that the numbers painted on the fuselages could be read. As a result, however, planes were not able to take advantage of winds aloft because they flew lower than they would have in an ordinary cross-country.

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Here are a few individual flight histories to show how pilots planned their flights and won first place in their respective classes:

BEECH BONANZA CLASS. Won by J. M. 'Jake' Arner, operations manager, Lehigh Aircraft Company, Inc., Allentown-Bethlehem Airport. Gasoline consumed, 7.25 gallons; average speed 114.7 m.p.h.

"We here at Allentown have run two of these races and from careful study of them and the formula, we deduced that more points could be scored on gas than on speed. This was proved when our Ed Dawson won the local regatta here at Allentown the week previous to the Philadelphia regatta.

"Dawson rode with me in the Philadelphia regatta and did a great deal in the navigation and the engineering of this flight. The settings were decided beforehand—1,500 r.p.m., 20 HG, and 100 octane gas to allow a leaner mixture without detonation. This particular engine runs very smooth at 1,500. It actually ran cooler on both head and oil temperature than normal.

"Our speed was a constant 128 indicated. We were never over 130 or under 120, even when changing altitude. We noted on passing pylons that the gap between us and leading ships usually closed. This no doubt helped our score.

"Our navigation was just plain point-to-point piloting, correcting for winds as we found them. Naturally, our magnetic courses were all worked out prior to the race. We found the wind hindered our speed greatly on two of the longest legs, quartering on the nose from the left on one and the right on the other. Our ground speed varied from a low of 102 m.p.h. to a high of 141.

"We believe that the official formula now being used will be altered so as to come out with a higher average speed, probably by incorporating a minimum speed into the rules of each class. This certainly would make the navigation part of the regatta an extremely interesting one."

BELLANCA CRUISAIR CLASS. Won by John G. Keaveny, chief test pilot of Bellanca Aircraft Corporation. Gasoline consumed, 15.5 gallons; average speed 143 m.p.h. (Keaveny reversed the trend of low-speed flying. Though he flew an average of 33 m.p.h. faster than the second place winner, he burned only 1.1 more gallons of gasoline.)

"A few weeks before the race, I did run a few cruising range tests on our ship, but not with the regatta in mind. In these tests we determined that the *Cruisair* had a cruising range of 725 miles on 40 gallons of fuel.

"Using a head temperature gauge on No. 3 cylinder (which runs hottest on the *Cruisair*), I found that I could lean the engine out without detonation, keeping the temperature well below the maximum.

"Since the points that we were to fly over were in a triangular pattern and fairly close together, I was unable to take advantage of altitude because our numbers had to be recognized by observers at these various points.

"I decided that my best plan would be to fly 'on the deck.' The majority of the points over which we flew were small airports, mostly sod fields that blended well into the surrounding terrain, and made it extremely difficult to reach each one accurately. We missed the Doylestown control point by about 20 miles and had to retrace the course at this position. Visibility was hazy and there was little wind.

"I flew the *Cruisair* at 2,300 r.p.m., which is 100 r.p.m. below normal cruise and had an indicated airspeed of 148 m.p.h. Incidentally, I find that the best procedure to lean out the Bellanca is first to cruise at full throttle, lean the mixture until a drop in r.p.m. is noticeable, and then bring the throttle back to cruise setting."

Tailor-Made Helmet

JET pilots can now have their own tailor-made helmets. Robert Edholm, chief test pilot of McDonnell Aircraft, is shown with his helmet being designed to guard against head wounds, harmful vibration, high temperatures and wind blast.

The first step for individualized fitting is to have a plaster of paris mold made of the pilot's head. The plaster is applied in successive layers over a swimming cap until the required thickness is reached. The hardened mold is then removed, filled with plaster of paris, and shipped to the helmet manufacturer.

The finished helmet has a one-half to one inch spacing filled with a non-resilient, energy-absorbing lining material between the head and helmet shell. The inside layer, composed of sponge rubber covered with chamois and provided with ventilation holes, is designed for maximum comfort. Ear phones are built in special "pockets." The outer shell is fabricated from four layers of laminated plastic cloth. Completed helmet, made by the Protective Equipment Co., Englewood, Calif., takes 60 to 80 days to manufacture and costs approximately $225.

CESSNA 120-140 CLASS. Won by Anthony Smolinski, president, Patco Air Service, Inc., Conshohoken, Pa. Gasoline consumed, 10.2 gallons; average speed, 100 m.p.h.

"The most essential contribution to my score was staying on course at all times. The navigation, by pilotage, must be as near perfect as possible—and fortunately it was. No winds aloft or wind triangles were used—just plain pilotage at altitudes of 800 to 1,000 feet.

"As far as cruise control is concerned, a constant airspeed was used. It was important that the ship was trimmed exactly right. I cruised at 105 m.p.h. indicated airspeed, which was really moving along, right up on the step. In order to maintain 105 m.p.h. it was necessary to reset the throttle quite often. When we were in an up-draft we could come back on the throttle and while in down-drafts it was necessary to apply more throttle.

"As far as leaning the mixture at that altitude and on an 85-h.p. engine, very little or practically none could be used to advantage, I believe."

NAVION CLASS. Won by W. E. Wells, Bonanza Farm, Parkerford, Pa. Gasoline consumed, 12.5 gallons; average speed, 113.8 m.p.h.

"My navigator, Vernon D. Shaffer, of Pottstown, Pa., and I plotted our course together. We found that the longest leg on the course was 63 miles. Our figures showed us that there was no advantage in climbing to gain help from the winds because we would lose on both our gas and time score. This happens because the rules of the Regatta said that we must be between 250 and 500 feet above the ground at each of the nine pylons. Based on these facts, we decided to fly the course at CAA minimum altitude. We now had our navigation plan established.

"Our remaining problem was the proper engine and prop control and settings for best gasoline economy and speed. We carefully looked over the well-known formula that is used in figuring points in all of this type of regatta. We found that our score would affect all other scores and all other scores would affect our score.

"Our decision was to try for the best time score or the best gas economy score. My figures told me that the score point gain was greater on fuel economy than on speed. We checked the Ryan *Navion* speed and gas economy chart and found that the *Navion* operates most economically at sea level with 118 m.p.h., 1,700 r.p.m., and eight g.p.h. Here I decided to use the following engine and prop settings, 1,650 r.p.m., 115 m.p.h. From experience with my *Navion* we knew that this would give us a manifold pressure of 25.50 inches on our manifold pressure gauge. We calculated that if we followed this plan closely we should be close to first place at the end of the course, and we did win, as it turned out."

STINSON CLASS. Won by J. T. McLamore, Haddonfield, N. J. Gasoline consumed, 17.5 gallons; average speed, 111.3 m.p.h.

"In planning this race, I considered it exactly as I would a cross-country trip where I would be required to obtain the greatest economy out of the plane. This

required having the following data available prior to the briefing for the actual race: (1) an accurate calibration of the compass, (2) performance curves on the engine, and (3) wind conditions.

"Immediately after the briefing the various courses were plotted on a chart. The headings were determined and a table was prepared with the following headings, and completed with a computer and plotter: (1) distance for each leg, (2) magnetic course for each leg, (3) magnetic heading for each leg, (4) compass heading for each leg, (5) estimated lapsed time for each leg.

"After considering the winds aloft, it was decided to stay at the lowest possible altitude permitted by CAA.

"I had flown my particular plane a total of only 15 minutes before the race, although I have been flying a Stinson for the past two years.

"Visibility was none too good and on at least one leg the landmarks were not very prominent so it was necessary to adhere almost entirely to a compass heading over a considerable part of the longer legs. The preliminary preparation certainly paid off in that I was able to hit each of the pylons practically on the nose.

"In regard to cruise control I decided on approximately 70 per cent h.p. and not having a head temperature gauge I had to use the mixture control with caution. However, previous experience on Stinsons had shown that I could lean the mixture until there is a noticeable drop, then richen the mixture slightly to get improved economy without overheating the engine. The use of some carburetor heat helps.

"In the actual race I did not attempt to hold very exactly a specific altitude. The air was farily rough and the plane was allowed to ride the thermals to the greatest extent possible.

"The plane was a Standard 1948 *Voyager* with a Macauley metal propeller. Tests prior to the race indicated that the propeller gave approximately 7 m.p.h. greater airspeed for the same power setting than the original wood propeller."

SWIFT CLASS. Won by A. C. Croff, Philadelphia. Gasoline consumption, 11.9 gallons; average speed, 118.3 m.p.h.

"After charting our courses, I called the weather bureau for the wind at 500 and 1,000 feet and the degree of wind. The reply was 500, 15 m.p.h.; 1,000, 10 m.p.h., from 210°. Then I wandered to an easy chair on the lawn and with my computer I adjusted all the courses for the wind. About this time all were called to take position with their planes and await their call. We were No. 91 and had just about all the fun of seeing the others take off.

"The only thing I mentioned to my navigator regarding the flying of the courses was the nearer we could keep to 500 feet on our N.E. courses the better and at or near 1,000 feet on the other courses. We had turned our first pylon and the engine and oil were warmed up when I began to maneuver the stick for airspeed. This was the second leg and a stretch of 63 miles. On this leg we passed a Bellanca and a *Navion*. At the second pylon we left two more "early birds" and at the sixth pylon two more. The real mystery to me was the whereabouts of the other 60-odd planes that we did not see.

"Last but not least of the contributing factors was the zero flying of the wing, or as near as possible. Losing 500 feet over a 50-mile course does a lot to put the airspeed of a 140-m.p.h. plane to 160 or 165 m.p.h."

Some of the performances of the aircraft during the regatta were unusual and worth considerable study. Three *Bonanzas*, for example, flew the course with a gasoline consumption of less than five gallons of gasoline per hour. Arner's winning plane actually averaged only 3.8 gallons per hour, which was less than any other plane in the race—even the two-placers—except D. Pinelli's winning Luscombe *Silvaire*, which burned only 3.5 gallons per hour, and Margaret Harrison's *Ercoupe* which burned 3.6. These amazing figures are evidence enough of the advantages to be gained from a closer study of cruise control techniques.

When one *Bonanza* will burn six gallons per hour while cruising only 1.5 m.p.h. faster than another burning 3.8 gallons per hour, there is evidently much to be learned on the subject.

Other air regattas may turn up some equally startling problems—and their solutions. Despite the rather artificial requirements of the present rules, the regattas are extremely valuable to perticipants in practicing cross-country navigation and cruise control techniques. With further development and modification of the rules, they could very easily turn into foremost pilot research laboratories. END

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Taylorcraft 85

(*Continued from page 36*)

early days when "C. G." designed the first Taylorcraft for his new company following his departure from what now is the Piper company. C. G., you know, is generally called "the father of the lightplane" because he designed the first *Cub* and, later, the Taylorcraft. It's fairly obvious, therefore, why most lightplanes—even today—resemble those original Taylor designs.

If any one thing about the 85-h.p. Taylorcraft impressed me, it is the plane's amazingly short take-off. Even discounting the fact that I flew this particular airplane (N-5625M) lightly loaded, its take-off performance was breath-taking. As a matter of fact, it was a problem for me to time the take-off with a stop watch. I would shove the throttle wide open while holding the brakes, reach quickly for the stop watch, then snap the starting button at the moment I released the brakes. Even so, the ship was in the air and flying before I had time to stop the watch. I made quite a few such take-offs, but was able to time them only by glancing at the sweep-second hand the instant the wheels left the runway. I made several of those take-offs in an average of four seconds.

Rate of climb also is startling. As it finally works out, it's not the *rate* so much as it is the *angle*, although the rate's pretty good for such a plane: over 700 f.p.m. (I got 810 f.p.m. on one climb). But the angle the plane assumes when you pull up to the recommended 50-m.p.h. indicated air speed makes you want to shove the nose down hard. After a few tries you gradually get to believe the ship won't stall out on you; from then on you devote your time to seeing how amazingly short a space you can climb out of. In CAA tests the ship, fully loaded, took off in 264 feet.

In the air the 85-h.p. Taylorcraft lives up to the reputation of its preceding models—a reputation that always has been good. Cruising speed, I found, works out to between 98 and 100 m.p.h. The noise level still is high at cruise (the engine is turning 2,350-2,400 r.p.m., which is part of the reason) and normal indicated air speed for cruising is 95.

The plane stalls at between 30 and 35 m.p.h. indicated (airspeed indicators are inaccurate at such low speeds), and aileron control is excellent at those speeds. With power off and the trim cranked full tail heavy, the ship I flew just floated along gently at 40 m.p.h. indicated, slowly mushing toward the ground. This obviously is an excellent safety feature, for the most ham-handed pilot could get this airplane down somewhere in an emergency without hurting himself or doing much damage to the ship.

With the wheel full back in the stall the Taylorcraft just oscillates gently, with the nose rising and falling slightly. There's not a thing violent or treacherous about the ship under those conditions. It even hangs on to those peaceful characteristics in stalling turns. I realize, of course, that there have been stall-spin accidents in Taylorcrafts—but they were surely the result of continual, extreme negligence, if I'm to judge from this airplane and other Taylorcrafts I have flown. The fact remains, though, that *no* pilot can really learn to detect approaching stalls under all conditions, the hotshots notwithstanding. So if I owned a lightplane—even this docile Taylorcraft—I'd add a stall-warning indicator to it. With that one addition I don't see how a pilot, no matter how inexperienced, could get into stall-spin trouble with this airplane.

Unfortunately, I have no way to measure a plane's landing roll when I'm flying it. For once, I wish I did. As soon as I got acquainted with the Taylorcraft's slow-speed and stall characteristics in the air, I started in on landings. The wind was 10 m.p.h. which, of course, is quite a bit of help with an airplane that lands at about 35. I found that the best way to slow down for the glide and landing was simply to crank the trim full back, ease off the power, and just sit. The Taylorcraft does the rest. It glides by itself at about 50 indicated. You just sit there and steer it down to the edge of the runway. Then ease back ever so slightly on the wheel and the speed drops off quickly. After two or three normal landings I found to my surprise that the runway I subconsciously had been using actually stayed out ahead of me all the time, unused. Both my landings and take-offs were being made from a short stub off the end of the actual runway. I'd be willing to bet I was taking off in less than 200 feet and landing in about 100. Looks a little balmy, I know, but I spent a lot of time doing it and that's honestly the way this airplane performed. Only three points favored that performance: the 10 m.p.h. wind, the light load, and the metal McCauley propeller (which is optional equipment; standard equipment is a wood Lewis prop).

TAYLORCRAFT BC12D-85
Type Certificate No. 696
One air-cooled 85-h.p. Continental engine

Wing span	36 feet
Length	22 feet
Height	6 ft. 6 in.
Gross weight	1,280 pounds
Empty weight	800 pounds
Wing loading	7.2 lbs./sq. ft.
Fuel capacity	18 gallons
Top speed (sea level)	110 m.p.h.
Cruising speed (90% power)	100 m.p.h.
Stalling speed	40 m.p.h.
Range fully loaded	350 miles
Rate of climb	600 f.p.m.

Source: Taylorcraft, Inc., Alliance, O.

Visibility—especially in the air—is not good, especially out the sides and to the rear. The side windows sit low; the wing root was even with my forehead. Forward visibility is satisfactory, although there are six pieces of tubing slanting across the windshield. I would say that this ship's restricted visibility probably is its worst feature.

The 1949 Taylorcraft's cabin is fairly roomy and comfortable, although my head did touch the cabin roof all the time I was in the ship.

As soon as you get in place and settled, you begin noticing the cabin interior. I found the heel-brake installations difficult to use, as they are in the other lightplanes that stick persistently to this outmoded braking system. There's nothing quite so exasperating—or dangerous, at times—as the foot fumbling you must do to locate the heel pedals, then safely use them, especially during a tricky landing.

The 1949 Taylorcraft's cabin appointments are quite nice. Instrument panel and control layout are neat, easily accessible and seem to be well thought out. Flight and engine instruments (there are only five altogether on the standard panel) are in the center of the dash, between the two control wheels.

The throttle is a standard push-pull rod in the center of a neat panel just below the main instruments. There are two knobs on each side of the throttle. The two on the left are for carburetor heat and gasoline cutoff, respectively. They're right next to each other, are the same size and shape—and many is the pilot who has pulled the fuel cutoff during an approach, thinking he was pulling carburetor heat. It would be quite simple to move the fuel cutoff knob clear over to the extreme right side of the panel, thereby cutting down that danger considerably. It's a seemingly small point of criticism, I know—but I've recently had two CAB accident reports come to my desk, both fatal, and both due to the pilot's inadvertently pulling the gas knob instead of the carburetor heat.

This airplane carries 18 gallons of fuel: 12 gallons in a fuselage tank just ahead of the windshield, and six in a tank in the right wing. The front tank is equipped with a float gauge which sits on top of the panel just behind the windshield. You're supposed to use fuel from that main tank first, then drain the six gallons from the wing tank into the main tank by turning a valve hidden under the instrument panel. It's a system Taylorcraft has been using for some time.

The double seat is comfortable, being equipped with Airfoam cushions. Directly behind the seat is a baggage compartment that will hold 50 pounds. There is a door on each side of the cabin, and each door is equipped with a sliding window. Cabin heating and ventilation are fairly good, although there are air leaks around the doors and windows that make quite a bit of noise in flight.

In cutting corners and trying to keep the price down, Taylorcraft has omitted an engine starter. It's my personal opinion that no private plane should be manufactured these days without a starter. The hand-propping of planes is as unnecessary as are open cockpits these days, and private pilots and plane owners have made their feelings on this score quite emphatic. Only one type of starter is offered as optional equipment on the Taylorcraft, and that's the McDowell hand-crank starter like that which is standard equipment in the Aeronca *Chief*. You operate it simply by turning the ignition switch to the left mag, then pushing the crank handle slowly forward to the last ratchet, then pulling back hard.

The prop snaps over once and, if it doesn't start, you simply push the handle forward and pull back again.

Other optional equipment includes navigation lights and battery. The ship also has been approved recently for skis and floats.

This model has proved to be Taylorcraft's most popular at the moment. As soon as the company gets settled at Conway, they plan to get to work on a four-place model, something like the company built experimentally a few years ago but did not market. C. G. has already started the preliminary work on that model in Alliance, where he will stay when the company moves. Conway is not far from Alliance, and Taylor will continue with the firm, but working from Alliance. He has two other non-aviation businesses in Alliance: beds and midget washing machines. He will continue to devote much of his time to them, working on the aviation projects as well.

He also plans to develop a spoiler installation that will be simple, effective and economical to install on all Taylorcraft models. If he does, it will be a worthwhile addition to his already good-performing personal planes. END

Jet-Propelled Lightplane

(*Continued from page* 25)

students from South Africa and South Dakota respectively, who planned the plane as a class project. The design caught the fancy of engineering instructor Jim Wilson, who had been projecting the development of the turbo-jet engine.

The marriage of the two projects was a natural—with development work being assigned to the engineering school in order to speed activity on the plane. Detail work was assigned to department heads for integration in their courses as a part of regular student activity.

Progress on the single place experimental model has reached the mock-up stage. Wind tunnel tests were completed in the Cal-Aero tunnel, and engine units are now being fabricated with tests scheduled for early spring. The experimental craft should be ready for flight tests next fall.

Top speed of the tiny jet plane is 250 m.p.h. At cruising speed, fuel consumption is 75 gallons per hour (with jet fuel costing slightly less than 10 cents per gallon). Range is 325 miles, rate of climb is 1,380 feet per minute, and service ceiling is 35,000 feet. These figures, of course, are based on estimated engine output.

Because of its simple structural design Cal-Aero engineers have determined that the price for such a plane could be set at $2,000 if produced in sufficient quantity —300 to 500 per year. Staff engineers report that the range can be stretched to 500 miles without materially reducing the top speed.

Still another application of the single-seat jet plane could be that of drone for use by the Air Force or Naval Air Force. With its superior performance and its low cost it would offer advantages over other craft currently projected for this use.

Though there is considerable interest in the single-seat craft, it is expected that the greatest public demand will be for the two-place private version of the plane now on the drafting boards at Cal-Aero.

With two passengers, an ample baggage allowance, and a range of 500 miles, the two-place jet will have a wing span of 30 feet to keep wing loading down. With the present engine, the larger craft would still have a top speed of 200 m.p.h.

Actual construction on the larger version of the XLC-1 jet will not get underway until the single-seater has been flown and the general configuration proved through a comprehensive test program.

Right along with the design of the larger plane, Cal-Aero staff men and student engineers are laying out plans for a more powerful engine—also to be fabricated from surplus materials. The new engine will be unique in that it will feature two compressor units—not on a common axis. It is anticipated that the new engine will materially boost the thrust output without unduly increasing fuel consumption.

The larger version of the jet plane probably could be sold for $2,500, based on a yearly production of 500. END

Third Man in Cockpit

(*Continued from page* 40)

gineer could have prevented the fatal chain of events by taking over the transfer job and giving it his undivided attention; something the pilots could not do when confronted with a host of special problems.

The Air Line Pilots Association is in 100 per cent agreement with the CAB in its contention that some of the air accidents in recent years could have been averted or would have been less serious if a flight engineer had been aboard.

Just what is a flight engineer supposed to do? The CAB has taken the stand that this is up to the airlines. It has declined to spell out his duties. The Board does not feel that it should try to define their exact nature in the regulations any more than it considers it would be desirable to dictate much other air carrier operating procedures.

Perhaps a better clew to what the Board has in mind is furnished by the official requirements for a flight engineer rating. To qualify, the applicant must be able to pass a written examination prescribed by the CAB covering the following subjects:

1. Responsibilities and limitations of a flight engineer as specified in the Civil Air Regulations.

2. Theory of flight and elementary aerodynamics.

3. Aircraft performance and aircraft engine operation with respect to limitations.

4. Mathematical computations of engine operation and fuel consumption, including basic meteorology with respect to engine operations.

(*Continued on page* 72)

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5. Aircraft loading and center of gravity computations.

6. Basic aircraft maintenance and operating procedures.

A pilot would need little additional training to qualify as a flight engineer, though a flight engineer would not necessarily have to have a pilot's rating. The additional knowledge required by a pilot deals mainly with basic aircraft maintenance and operating procedure with special emphasis on engines.

Since most airlines have more pilots than they are currently using, they are already drawing on this reservoir in complying with the order. Few new recruits have been hired from the outside. Thus, regardless of what the long range implications may be, the immediate effect is not going to be the creation of new job opportunities. All the airlines will need to do is to give some of their extra pilots additional courses in engine maintenance and operation as well as the mechanical side of aviation generally.

Privately, CAB experts express the view that the airlines will soon find that the flight engineer will come close to paying his own freight in operating savings alone. They call attention to the Air Forces' experience during the war when cruise control techniques stepped up the range of combat planes as much as 30 per cent. Cruise control consists mainly of giving special consideration to such factors as wind and the weight of aircraft as they relate to engine control.

Some of the trans-oceanic airlines already have indicated that a flight engineer pays for his own weight in the amount of gas he saves.

In addition, it is considered most likely that the flight engineer will take over the immediate responsibility for pre-flight inspection. From the nature of the duties most airlines are assigning him, he will be in an excellent position to observe the functioning of equipment and instruments and to spot anything that appears to be going wrong. For example, he will be able to tell the ground crew a little more than: "check number three engine." He will be able to say instead: "Number three engine is having sparkplug trouble."

A good indication of the way the airlines are carrying out the order is supplied by United. United announced that the third member of the crew will be a "pilot-engineer" and that he will be known as a "second officer." The other two crew members serving in the cockpit are "captain" and the "first officer."

Duties of the second officer, according to the United plan, will include pre-flight inspection of the airplane, in-flight observance of the functioning of equipment and instruments, log recordings with particular reference to any malfunctioning, checks on fuel consumption, and reports on the aircraft's performance after flight.

Eligibility as outlined by United includes the following requirements: age, 21 to 30 years; height, 5 ft. 7 in. to 6 ft. 2 in.; weight, normal; two years of college with engineering training preferred; 500 hours minimum pilot time with 1,000 hours preferred and multi-engined experience desirable; commercial certificate and instrument rating; aircraft radio operator's license, and ability to pass pre-employment examinations including mechanical aptitude tests.

Without doubt, the long range implications in the flight engineer order are more important than the immediate effects. CAB has made it clear that the order is temporary. What it is trying to do is to impose some immediate requirement for an extra crew member in the interest of safety and then step up its studies of the problem to determine more precisely the necessary flight crew complement for larger aircraft.

CAB is not entirely satisfied with the criteria it has used in defining current regulations. For example, it realizes that in making 80,000 pounds in take-off weight and four engines the determining points for the application of the order it was being somewhat arbitrary. But it had to start somewhere.

Also the Board took special pains to point out that it was not freezing the design of future transport planes. It believes that when the industry is again on the verge of developing some big new transports, a new approach to the flight crew complement will be available.

Eventually, the crew of the larger aircraft may consist of a master captain and two pilots. But this is merely a matter of nomenclature. What the CAB is trying to devise is a better method of determining the minimum number of men who should man the cockpits of the big transports. It is always willing to be shown that simpler design can reduce the size of the crew required. But it definitely rejects the contention that mere "automaticity" is the answer. The Board does not believe that a huge Goliath of the air can be operated safely by a reduced crew just because it has more gadgets on it. The question it asks in such cases is: "What if some of them don't work?" END

Fighters or Missiles?

(*Continued from page* 21)

insists on going along.

Manned supersonic fighters are bound to come along eventually, but there are tremendously complicated basic problems yet to be solved. The recent breakthrough of the barrier by the Bell X-1 in a vertical power climb and the F-86 in a dive proved that manned supersonic planes are possible. But are they practical? Can the operational problems be solved—fuel and range problems, temperature and cabin cooling problems, the effects of high speed maneuvers on the human body, and so on? And *all* must be solved before a squadron of supersonic fighters can take to the air. Can the equipment to allow men to fly at such speeds be developed before the guidance systems are perfected for accurately controlled missiles?

Certain difficulties confronting supersonic fighters prompt some scientists to suggest that perhaps supersonic guided missiles may be the answer. Since we can't quote our own experts on the role that missiles will play in our 1953 target-day air defense, we must fall back on the theories of those who all but perfected the guided missile as a tactical weapon during the past war.

Dr. Wurster, chief test pilot for Messerschmitt (he once held the world's speed record in a souped-up Messerschmitt Me-109 fighter) once summed up the arguments for the guided-missile and these arguments seem just as valid today as they did five years ago. Dr. Wurster was the project engineer on the rocket-propelled Messerschmitt Me-163 interceptor and designed and built the radio-controlled *Enzian* flak-rocket at the end of the war.

His argument for the guided-missile was just this. The drag proportionality factor—the drag-coefficient—has been demonstrated to be higher at supersonic speeds even under the best of conditions and even with swept wings or short stubby low aspect-ratio wings. At Mach 1.2, for example, the drag-coefficient may be 50 per cent greater than it is for Mach 0.9. A terrific increase in power thus is required for even a modest increase in speed. As the power increases so does the fuel consumption—and down goes the bomb or ammunition load. Can a supersonic fighter, therefore, carry enough of any known fuel to have a tactically useful flight range at supersonic speeds?

On the other hand, a missile will require only a fraction of the power that a fighter will. It would be very much smaller—there is no landing-gear or cockpit equipment and the wings can be small fin-like surfaces with extremely high wing-loadings since it doesn't have to land or take off as does a fighter. It can quickly slip through the difficult transonic region in a quick burst of speed at launching while still in a stable vertical attitude. It can then quickly accelerate to supersonic speed and slam into a bomber at maximum speed rather than jockey around as a fighter would at a speed depending somewhat on circumstances.

The missile can maneuver much more rapidly at high speeds—and hence improve its chances of intercepting the bomber since the metal muscles of the missile are fantastically tougher than those of a human being. The missile doesn't "black-out" at high speeds and high accelerations.

With an infra-red, radar, radio, or television homing device, it can chase the bomber just as effectively as can a fighter. When near the bomber, a radio proximity fuse which senses the presence of the bomber, automatically explodes the missile. And then the question can be asked, once in position, which would do the most damage, the burst of a 1,000 pound warhead or the accumulative effects of a barrage of cannon shells from a fighter?

A missile is a very dangerous adversary when viewed from the sighting stations of a bomber. It is smaller and faster than a fighter, much more elusive, and even with radar-tracking and aiming equipment and remote automatic turrets

throwing out rapid-fire proximity-fused cannon shells a missile would be very hard to hit.

Missiles can be built for only a fraction of the cost of a fighter and can be "operated" far more economically. They require a relatively modest launching apparatus and only a small ground crew—certainly far fewer than does a fighter base. They can be launched from practically anywhere—mountain tops, beaches, parkways—or your back yard.

That is the argument for the ground-to-air guided-missile as against the interceptor-type fighter plane. It requires a fixed defense, however, and a network of launching sites surrounding the area to be protected. But it can be made mobile and when it is the guided-missile and the fighter combine to form a complete tactical weapon.

High-speed fighters, like the swept wing F-86, could fire air-to-air rockets to catch the high-speed bombers if hostilities were to break out the day after tomorrow. Consequently, while fighters themselves may not be able to catch and attack bombers, they can be the means of launching a projectile than can.

The effectiveness of a missile is increased tremendously when launched from the air. Its range is then that of the fighter plus its own, while the warhead can be larger for a given all-up weight since the launching fuel required to climb from the ground is eliminated. Launching facilities are eliminated along with rocket-boosters and other complicated bits of apparatus.

And so we're right back to the classical stratagem of carrying the primary striking weapon with a secondary vehicle—bombers carrying bombs, fighters acting as machine-gun platforms—and foot-soldiers carrying rifles. The fighter would now act as a launching device to extend the range and mobility of the basic projectile—the missile. Instead of carrying guns and cannon shells, it would act as the mother plane and guide and control the missile towards its target.

This immediately suggests that the bomber would carry air-to-ground missiles instead of conventional bombs, and launch them quite some distance from the target and so avoid the fighters with their mobile missile maneuvers. This would seem to be the logical future for the heavy offensive missiles rather than ultra-large V-2s launched from the ground. Experts say that V-2s are already obsolete from the point of view of size required for weight of warhead delivered, per mile of range, per degree of accuracy. After all, an air-launched supersonic missile would be just as unstoppable as would one launched from the ground and would be vastly more flexible in its tactical use.

In the future the original cops-and-robbers game of fighters versus bombers may be placed on a strictly missile basis with both acting merely as missile carriers to increase their mobility and range when used either offensively or defensively.

The battle line would tend to be pushed back from the immediate target area, with interception taking place many miles away before the attacking bomber could get within range and launch its missile. Once a supersonic missile is launched what can be done to intercept it? Another supersonic missile? Radar and radio jamming of its control and guidance system? No positive defense can be visualized at the present time. There will be a defense. There must be. But until there is, the classic military maxim will never have been so appropriate: the best defense is a lightning-like offense.

—END

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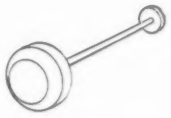
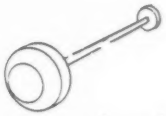


—apply full carburetor heat



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—on airplanes so equipped, check the fuel pressure gauge and if low use the auxiliary fuel pump

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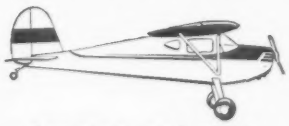

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